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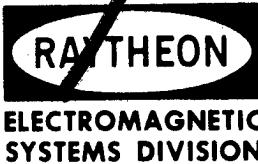
APPENDIX 6
SYSTEM CONTROLLER EXECUTIVE DESIGN SPECIFICATION
FINAL SOFTWARE REPORT
DATA ITEM NO. A005

# INTEGRATED ELECTRONIC WARFARE SYSTEM
# ADVANCED DEVELOPMENT MODEL (ADM)

78009877-7

PREPARED FOR:

NAVAL AIR DEVELOPMENT CENTER
WARMINSTER, PENNSYLVANIA

CONTRACT N 2269-75-C-0070

**RAYTHEON**

**ELECTROMAGNETIC
SYSTEMS DIVISION**

1 OCTOBER 1977

TYPE OF SPEC

# COMPUTER SUBPROGRAM DESIGN DOCUMENT

TITLE OF SPEC

# SYSTEM CONTROLLER EXECUTIVE, IEWS, ADM

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1.0    SCOPE

1.1    IDENTIFICATION

This document specifies the detailed design requirements of the System Controller (SC) Executive Function (EXEC) subprogram for the Advanced Development Model (ADM) of the Integrated Electronic Warfare System (IEWS).

1.2    SUBPROGRAM TASKS

A copy of the EXEC shall reside in each of the following SC processors:

1.    Resource Management (RMP)
2.    Classification (CP)
3.    Analysis (AP)

The mnemonics assigned to the three EXEC's shall be, respectively:

1.    EXRM
2.    EXCP
3.    EXAP

Each EXEC shall be the primary control module for the operational software in each of the three processors. Each EXEC and the ECM processing modules assigned to that EXEC shall constitute a real-time operating system with priority multi-tasking capability. The three EXEC's shall communicate with each other to initiate and coordinate ECM processing in each of the three processors. The three EXEC's shall be similar in design. Differences among the three shall be as specified in this document.

In order to perform the tasks required for the servicing and control of ECM processing modules, the Executive function shall be divided into five subfunctions:

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1) Initialization sequence (EXINT)

2) Interrupt handlers

    (a) RMP:   Bus hung (EXHNG)
                Real-time clock (EXTIM)

    (b) CP:    Bus hung (EXHNG)
                Real time clock (EXTIM)
                Sorter power fail (EXSPF)
                Sorter high-priority message (EXIH)

    (c) AP:    Bus hung (EXHNG)
                Real time update from RMP (EXTIM)
                Aux Bus Interface buffer full (EXBF)

3) Task manager (ECM Processing Manager)

    (a) Scheduler (EXSCD)

    (b) Dispatcher (EXDIS)

4) Executive message handler

    (a) ECM-to-Exec interface (EXMES or EXMSG)

    (b) Executive message processing routine (XMES)

    (c) Intraprocessor communication message blocks (MTB's)
        Manager (GTMN and FRMN)

5) Interprocessor communication interface

    (a) Message receiver (EXIPR)

    (b) Message sender (EXIPS)

    (c) Interprocessor communication memory blocks (MCB's)
        Manager (GTMNC and FRMNC)

    (d) Special interprocessor communication (EXSSS, EXSTE)

## 2.0 REFERENCE DOCUMENTS

### 2.1 PERFORMANCE SPECIFICATIONS

The CPPS for the System Controller Unit, Integrated Electronic Warfare System (IEWS), Advanced Development Model (ADM), Raytheon Document No. 061290529, paragraph 3.3.1 shall apply to this subprogram.

### 2.2 DESIGN SPECIFICATIONS

The CPDS for the System Controller Program, IEWS, ADM Specification No. 53959-GT-0759, Section 3, paragraph 3.2.2, Table IIA, and paragraphs 3.2.3., 3.2.3.1, and 3.2.3.2 shall apply to this subprogram.

### 2.3 DATA BASE DESIGN DOCUMENT

The Common Data Base Design Document, System Controller Unit, IEWS, ADM, Document No. 53959-GT-0751, shall apply to this subprogram.

### 2.4 MISCELLANEOUS DOCUMENTS

The following documents shall apply to the subprogram:

| Document No. | Document Title |
|---|---|
| WS-8506, Revision 1, 1 November 1971 | Requirements for Digital Computer Program Documentation |

3.0    <u>REQUIREMENTS</u>

3.1    SUBPROGRAM DETAILED DESCRIPTION

3.1.1    <u>Introduction</u>

IEWS System Controller operational software shall consist of ECM processing software and control software.   ECM processing software is the implementation of the algorithms required to analyze and react to the ECM environment.   Control software (i.e., the Executive) is the software that:

1)    shall initialize all operational software and hardware

2)    shall respond to interrupts generated by IEWS hardware units (e.g., Real Time Clock) and subsystems (e.g., Signal Sorter)

3)    shall provide control of ECM processing modules (task management)

4)    shall allow the three SC processors (RMP, CP, and AP) to communicate with each other

5)    shall allow the SC to communicate with the Signal Sorter (SS) and Special Test Equipment (STE)

6)    shall allow the ECM processing software to communicate with the control software.

The control software shall maintain control of the ECM processing through the use of interrupts from external devices (e.g., Signal Sorter, Real Time Clock, etc.).   Control software (i.e., the Executive) shall also be known as "foreground processing".   The ECM processing software shall also be known as "background processing", because it is executed at the request of the foreground and because it can be interrupted by the foreground.

The Executive function (i.e., the control software) shall consist of five subfunctions:

1) Initialization Sequence (EXINT)

2) Interrupt Handlers

3) ECM Processing Management (EXSCD and EXDIS)

4) Executive Message Handler (EXMES)

5) Interprocessor Communications Management (EXIPR and EXIPS)

The overall structure of each of the three Executives is shown in Figures 1, 2, and 3 (RMP, CP, and AP respectively). Rectangular blocks represent software modules and circular blocks represent data structures.

### 3.1.2 Initialization Sequence (EXINT)

EXINT shall be the starting address for the stored operational program in the RMP, CP, and AP. Control shall be sent to EXINT in the RMP (the master processor in the SC) by the SC loader, after the loader has completed the loading of all IEWS operational software. Control shall be sent to EXINT in the CP and AP by the RMP's initialization sequence. The three initialization sequences are significantly different. However, the operations performed by each sequence can be categorized as follows:

1) Set stack register to initial value

2) Initialize (i.e., halt) all slave processors

3) Initialize interprocessor communication data (MCB's free queue, lockout flags, polling flags, and chain pointers)

4) Initialize intraprocessor message blocks (MTB's) free queue

5) Initialize common data base items

6) Initialize hardware units

7) Initialize interrupt trap memory locations

8) Initialize task management queues

9) Newstart (put into run mode) all slave processors

System "GO"
Command from Loader

Initializer
(EXINT)

Exec
Task
Table

Dispatcher
(EXDIS)

Return
MTB
(FRMN)

Background
ECM
Task

Priority
Task
Queues

Free
MTB
Queue

Scheduler
(EXSCD)

Request
MTB
(GTMN)

Executive
Message
Handler
(EXMSG,
EXMES)

and

Executive
Message
Processing
(XMES)

STE
Sender
(EXSTE)

SC/STE
Circular
Buffer

Msgs
to
STE

Message
Table

Inter-
processor
Sender
(EXIPS)

RMP-
to-CP
Msg Xfer
Queue

Msgs
to
CP

RMP-
to-AP
Msg Xfer
Queue

Msgs
to
AP

Message
Priority
Table

RMP/
CP Free
MCB
Queue

Request
MCB
(GTMNC)

Return
MCB
(FRMNC)

Inter-
process.
Rcvr.
(EXIPR)

CP-To-
RMP
Msg Xfer
Queue

Msgs
from
CP

RMP/
AP Free
MCB
Queue

AP-To-
RMP
MsgXfer
Queue

Msgs
from
AP

Bus Hung
Interrupt
Handler
(EXIING)

Real Time Clock
Interrupt Handler
(EXTIM)

STE-
to-SC
Msg
Buffer

Msgs
from
STE

Bus Hung
Interrupts

Real Time Clock
Interrupts

Figure 1.  RMP EXEC Block Diagram

"Newstart"
Command from RMP

Initializer
(EXINT)

Exec
Task
Table

Dispatcher
(EXDIS)

Sorter Lo-
Priority Msg
Polling

Sorter
Lo-Pri.
Msg
Buffer

Lo-Pri.
Msgs
from Sorter

Return
MTB
(FRMN)

Background
ECM
Task

Priority
Task
Queues

Free
MTB
Queue

Scheduler
(EXSCD)

Request
MTB
(GTMN)

Executive
Message
Handler
(EXMSG,
EXMES)

and

Executive
Message
Processing
(XMES)

Message
Table

Sorter Msg
Interrupt
Handler
(EXIH)

Sorter Msg
Interrupts

Sorter
Hi-Pri.
Msg
Buffer

Hi-Pri.
Msg from
Sorter

Real Time
Clock Interrupt
Handler
(EXTIM)

Real Time
Clock Interrupt

Sorter
Lo-Pri
Msg
Buffer

Lo-Pri.
Msg from
Sorter

Interpro-
cessor
Sender
(EXIPS)

Request
MCB
(GTMNC)

RMP/CP
Free MCB
Queue

CP/AP
Free MCB
Queue

Return
MCB
(FRMNC)

Interpro-
cessor
Receiver
(EXIPR)

RMP-To
CP Msg
Xfer
Queue

Msgs from
RMP

AP-To
CP Msg
Xfer
Queue

Msgs from
AP

Message
Priority
Table

CP-To
RMP Msg
Xfer
Queue

Msgs to
RMP

CP-To
AP Msg
Xfer
Queue

Msgs to
AP

Sorter
Sender
(EXSSS)

To
Sorter Hi
Pri. Msg
Buffer

Hi-Priority
Msgs to
Sorter

To
Sorter Lo
Pri. Msg
Buffer

Lo-Priority
Msg to
Sorter

Bus Hung
Interrupt
Handler
(EXIING)

Sorter Power
Fail Interrupt
Handler
(EXSPF)

Bus Hung
Interrupts

Sorter Power
Fail Interrupts

Figure 2.   CP EXEC Block Diagram

"Newstart" Command
from RMP

Initializer
(EXINT)

Real Time
Update
Interrupt
Handler
(EXTIMT)

Real Time
Update
Interrupts
from RMP

Exec
Task
Table

Dispatcher
(EX DIS)

Priority
Task
Queues

Background
ECM
Processing

Return MTB
(Called via
EXMSG)

Free
MTB
Queue

Request MTB
(GTMN)

Scheduler
(EXSCD)

Executive
Message
Handler
(EXMSG,
EXMES)

and

Executive
Message
Processing
(XMES)

Message
Table

Message
Priority
Table

Interpro-
cessor
Sender
(EXPIS)

Request
MCB
(GTMNC)

RMP/AP
Free MCB
Queue

Return
MCB
(FRMNC)

Interpro-
cessor
Receiver
(EXIPR)

RMP-to
AP Msg
Xfer
Queue

Msgs
from
RMP

CP/AP
Free MCB
Queue

CP-to
AP Msg
Xfer
Queue

Msgs
from
CP

AP-to
RMP Msg
Xfer
Queue

Msgs
to
RMP

AP-to
CP Msg
Xfer
Queue

Msgs
to
CP

Bus Hung
Interrupt
Handler
(EXHNG)

Aux Bus Inter-
face Data
Buffer Full
Interrupt (EXBF)

Bus Hung
Interrupts

Aux Bus Interface
Data Service Interrupts

Figure 3. AP EXEC Block Diagram

10)    Enable all interrupts

11)    Exit to Executive dispatcher (EXDIS)

The three initialization sequences shall be specified by the following tables:

1)    RMP Initialization        Table 1

2)    CP Initialization         Table 2

3)    AP Initialization         Table 3

## 3.1.3    Interrupt Handlers

Interrupt handlers shall be the set of routines immediately called in response to an interrupt in the RMP, CP, or AP. The addresses of the interrupt handlers for a given processor shall be loaded by EXINT into the interrupt trap addresses assigned in that processor. The contents of the trap addresses are used as indirect addresses by the RP-16 to call the appropriate interrupt handler when the interrupt occurs. Tables 4, 5, and 6 define the priority interrupt structure in the RMP, CP, and AP respectively.

Each interrupt handler is unique, but the general structure shall be:

1)    Save A, B, E, and X-register contents on stack.

2)    Take action appropriate to the interrupt (usually the scheduling of a driver, i.e., task)

3)    Restore A, B, E, and X-register contents

4)    Re-enable the interrupt

5)    Return to program executing at the time of interrupt.

It should be noted that the contents of the overflow flip-flop is not saved by the interrupt handlers. If this flip-flop is to be tested (Jump on overflow instruction), the following sequence of instructions shall be required:

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## TABLE 1

### RMP INITIALIZATION SEQUENCE

| Item No. | Description |
|---|---|
| 1. | Set S-register to high address of memory reserved for stack |
| 2. | Initialize Technique Generator Processor (TG) |
| 3. | Initialize CP |
| 4. | Initialize AP |
| 5. | Link together interprocessor message blocks (MCB's) used in RMP/CP communication |
| 6. | Clear RMP/CP interprocessor communication lockout flags, polling flags, chain pointers, next link pointers |
| 7. | Link together interprocessor message blocks (MCB's) used in RMP/AP communication |
| 8. | Clear RMP/AP interprocessor communication lockout flags, polling flags, chain pointers |
| 9. | Link together intraprocessor message blocks (MTB's) |
| 10. | Clear Azimuth Link Table (AZ) |
| 11. | Clear IEWS System Time<br><br>(Systim 2, Systim 1- RMP/CP copy)<br>(Systim 4, Systim 3 - RMP/AP copy) |
| 12. | Initialize encoding threshold current value to maximum value (value of SYTHU) |
| 13. | Initialize Jam Status File (JS)<br><br>Files 0, 2, 13, 15: Inactive<br>All Others: Active |
| 14. | Clear Resource File (RF) |
| 15. | Initialize Display/Control Status File (CD) All words cleared except (CD + 2) x '8000' |
| 16. | Clear Polar Image File (PI) |
| 17. | Clear Alphanumeric Image (AN) |
| 18. | Initialize Alphanumeric Memory pointer (ACPTR) - to-start address of Alphanumeric memory (AC) |

## TABLE 1

### (Continued)

| Item No. | Description |
|---|---|
| 19. | Unit clear Emitter Tracker (ET) |
| 20. | Unit clear Parameter Encoder (PE) |
| 21. | Call System Management 2 Driver to interrogate INS and transfer aircraft parameters of heading, altitude, pitch and roll to Common Data Base and store encoding threshold current value and azimuth correction factor in SC/PE Interface |
| 22. | Clear program load lamp on polar display |
| 23. | Initialize Serial I/O Channel 2 (Alphanumeric display) |
| 24. | Store addresses of 16 interrupt handlers in memory trap locations |
| 25. | Unmask (via PIN/RTC mask register) interrupt levels |
| |     1    Bus Hung |
| |     2    Real Time Clock |
| 26. | Reset Real Time Clock counter and set interval to 2 msec |
| 27. | Enable hung bus detector |
| 28. | Clear task management queues |
| 29. | Store address of watchdog timer expiration routine (EXWDG) in watchdog trap address and enable watchdog timer |
| 30. | Newstart TG |
| 31. | Newstart AP |
| 32. | Newstart CP |
| 33. | Enable high level interrupt |
| 34. | Enable low level interrupt |
| 35. | Unconditional exit to executive dispatcher (EXDIS) |

## TABLE 2

### CP INITIALIZATION SEQUENCE

| Item No. | Description |
|---|---|
| 1. | Set S-Register to high address of memory reserved for stack |
| 2. | Initialize Signal Sorter |
| 3. | Link together interprocessor message blocks (MCB's used in CP/AP communication |
| 4. | Clear CP/AP interprocessor communication lockout flags; polling flags, chain pointers, next link pointers |
| 5. | Link together intraprocessor message blocks (MTB's) |
| 6. | Set amplitude threshold constant (ATC) to 5 |
| 7. | Clear From - SS high priority message interrupt |
| 8. | Store addresses of 16 interrupt handlers in memory trap locations |
| 9. | Initialize Emitter Track File (ETF) by calling SOIE (Initialize 1 ETF entry) 128 times. |
| 10. | Unmask (via PIN/RTC mask register) interrupt levels<br>    1  Bus hung<br>    2  Real Time Clock<br>    3  Signal Sorter Power Fail<br>    4  Signal Sorter Hugh Priority message |
| 11. | Reset Real Time Clock counter and set interval to 2 msec |
| 12. | Enable hung bus detector |
| 13. | Clear task management queues |
| 14. | Newstart Signal Sorter |
| 15. | Send "Sorter Start" message to Signal Sorter |
| 16. | Enable high level interrupt |
| 17. | Enable low level interrupt |
| 18. | Unconditional exit to executive dispatcher (EXDIS) |

## TABLE 3

### AP INITIALIZATION SEQUENCE

| Item No. | Description |
|---|---|
| 1. | Set S-Register to high address of memory reserved for stack |
| 2. | Clear AP/CP interprocessor communication next link pointers |
| 3. | Link together intraprocessor message blocks (MTB's) |
| 4. | Call ABI Management 2 initializer (AB2IN) |
| 5. | Set value of interrupt counter (CTR) to 5 |
| 6. | Store addresses of 2 interrupt handlers in memory trap locations |
| 7. | Clear task management queues |
| 8. | Enable high level interrupt |
| 9. | Enable low level interrupt |
| 10. | Unconditional exit to executive dispatcher (EXDIS) |

TABLE 4

RMP INTERRUPT STRUCTURE

| Hex Trap Address | Interrupt Handler Mnemonic | HI of LO Priority | Interrupt Name | Comments |
|---|---|---|---|---|
| 9000 | NOTUSD | LO, Ø | Wired to output interrupt Ø | Used for test purposes only. High level interrupt is unused. |
| 9008 | EXHNG | LO, 1 | Bus Hung Detector | PIN/RTC module vectors low level interrupts. |
| 9010 | EXTIM | LO, 2 | Real Time Clock | |
| 9018 | NOTUSD | LO, 3 | CP-sourced interrupt | Not used in IEWS, ADM |
| 9020 | NOTUSD | LO, 4 | AP-sourced interrupt | " |
| 9028 | NOTUSD | LO, 5 | Serial I/O Ch 1 | " |
| 9030 | NOTUSD | LO, 6 | Serial I/O Ch 2 | " |
| 9040 | NOTUSD | LO, 8 | Serial I/O Ch 4 | " |
| 9048 | NOT USD | LO, 9 | Daisy Chain | " |
| 9050 | NOTUSD | LO, 10 | Daisy Chain | Not used in IEWS, ADM |
| 9058 | NOTUSD | LO, 11 | Daisy Chain | " |
| 9060 | NOTUSD | LO, 12 | Daisy Chain | " |
| 9068 | NOTUSD | LO, 13 | Daisy Chain | " |
| 9070 | NOTUSD | LO, 14 | Daisy Chain | " |
| 9078 | NOTUSD | LO, 15 | Daisy Chain | " |
| 9038 | NOTUSD | LO, 7 | Serial I/O Ch 3 | " |

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TABLE 5

CP INTERRUPT STRUCTURE

| Hex Trap Address | Interrupt Handler Mnemonic | HI or LO Priority | Interrupt Name | Comments |
|---|---|---|---|---|
| 0 | NOTUSD | HI | RMP-sourced interrupt | Not used in IEWS, ADM |
| 8 | EXHNG | LO, 1 | Bus Hung detector | PIN/RTC module vectors low level interrupts |
| 10 | EXTIM | LO, 2 | Real Time Clock | |
| 18 | EXSPF | LO, 3 | Signal sorter power fail | |
| 20 | EXIH | LO, 4 | Signal sorter message | |
| 28 | NOTUSD | LO, 5 | Serial I/O Ch 5 | Not used in IEWS, ADM |
| 30 | NOTUSD | LO, 6 | Serial I/O Ch 6 | Not used in IEWS, ADM |
| 38 | NOTUSD | LO, 7 | Wired to output Interrupt Ø | Not used in IEWS, ADM (Used for test purposes only) |
| 40 | NOTUSD | LO, 8 | Unused | Not used in IEWS, ADM |
| 48 | NOTUSD | LO, 9 | " | " |
| 50 | NOTUSD | LO, 10 | " | " |
| 58 | NOTUSD | LO, 11 | " | " |
| 60 | NOTUSD | LO, 12 | " | " |
| 68 | NOTUSD | LO, 13 | " | " |
| 70 | NOTUSD | LO, 14 | " | " |
| 78 | NOTUSD | LO, 15 | " | " |

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TABLE 6

AP INTERRUPT STRUCTURE

| Trap Address | Interrupt Handler Mnemonic | HI or LO, Priority | Interrupt Name | Comments |
|---|---|---|---|---|
| 0 | EXTIM | HI | RMP – sourced clock interrupt | Generated by RMP every 10 msec. |
| 1 | EXIH | LO | All of the following low level interrupts:<br>1. Bus hung detector. (EXHNG)<br>2. ABI Data Buffer Full (EXBF) | No PIN/RTC module is resident in AP. Interrupt vectoring is performed by EXIH. |

1. Disable interrupts

2. Reset overflow flip-flop

3. Perform operation which may set overflow flip-flop (e.g., divide)

4. Test overflow flip-flop

5. Enable interrupts

3.1.4    Task Manager (EXSCD and EXDIS)

The task manager, which shall also be known as the ECM processing manager, shall consist of two routines:

1.    EXSCD:  The Executive Scheduler Subroutine

2.    EXDIS:  The Executive dispatcher

3.1.4.1    Executive Scheduler Subroutine - EXSCD shall be an internal routine (called only by executive routines, i.e., control software). Its function shall be to place a message transfer block (MTB) on one of the priority task queues. The MTB's in this context can be thought of as task control blocks. Word $\emptyset$ of the MTB shall always be an executive message number (see CDBDD) when the MTB is being used as a task control block. The executive message number shall be used to call the appropriate driver (task) when the driver is to be dispatched. There shall be two priority task queues. All requests for ECM processing shall be placed on the low priority queue with the following exceptions:

1.    In the CP, New Emitter Alert messages received by EXIH from the Signal Sorter via the high-priority message buffer and destined for Sorter Message Processing (SODR), and

2.    In the AP, requests to execute the Analysis Return Driver (ABRDR) generated by the receipt of Aux Bus Data Buffer Full interrupt by EXBF.

3.1.4.2 <u>Executive Dispatcher</u> - The function of EXDIS shall be to search the priority task queues for the next request for ECM processing and to transfer control to the driver assigned to servicing that request. The algorithm for determining the next request to be serviced shall be as follows:

1. All requests on the high priority queue shall be dispatched before a request on the low priority queue can be serviced.

2. Within priorities, servicing shall be on a FIFO basis.

Control shall be transferred to EXDIS:

1. At the completion of EXINT

2. After the completion of an ECM processing task (Executed as a subroutine)

3. When the task queues are empty

The CP version of EXDIS shall poll the low priority message buffer from the Signal Sorter as its idle loop. That is, when the CP task queues are empty, the message buffer shall be polled before the queues are re-searched. If a message from the Sorter is present, an MTB shall be obtained (via GTMN), the message copied from the low priority buffer to the MTB, and the Sorter Message Processing Driver (SODR) scheduled.

3.1.5 <u>Executive Message Handler (EXMES, XMES, GTMN, FRMN)</u>

The Executive message handler shall be the Executive module responsible for processing all communication sent from ECM processing to the Executive. The Executive message handler shall then decide if the message is interprocessor in nature, intraprocessor, or special, and take the appropriate action.

3.1.5.1 <u>Executive Message Handler (EXMES or EXMSG)</u> - EXMES shall receive from the ECM processing routine the address of an executive message in the X-register. EXMES shall simply:

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1. Disable interrupts

2. Call XMES to do the actual message processing

3. Enable interrupts

4. Return to calling routine

3.1.5.2  Executive Message Processing (XMES) - XMES shall be the message switching routine of the Executive message handler. XMES shall only be called from the control software (EXEC). XMES shall be driven by two tables:

1. MTAB, the message routing table, and

2. PTAB, the message priority table.

There shall be an entry (one 16-bit word) in each of these tables for each Executive message type. XMES shall get the message number from the incoming message and get the corresponding MTAB entry. If the MTAB entry is all ones, the incoming message is destined for another processor (RMP, CP, or AP). EXIPS shall be called to perform the processing to that end. If the MTAB entry is zero, the incoming message is destined for a driver in the same processor. To do the message switching:

1. An MTB shall be obtained from the queue of available MTB's (via a call to GTMN)

2. The incoming message shall be copied to the MTB.

3. The MTB is placed on one of the priority task queues, using the priority obtained from PTAB (call to EXSCD)

If the MTAB entry is not all ones and not zero, it is used as an address to which control shall be sent to do special processing. Special processing shall include:

1. Request (Executive message type 24) and release (Executive message type 25) of MTB's for ECM processing (i.e., Candidate List management in CP, task control block release in AP).

2.    Event flag setting/resetting.

    (a)  Alphanumeric update flag setting in the RMP (Executive message type 18)

    (b)  Display flag setting in the RMP

3.    Routing of Executive message type 5 from the RMP to the STE and routing of Executive message type 19 from the CP to the Signal Sorter.

3.1.5.3   MTB Management (GTMN and FRMN) - The memory blocks used for intraprocessor task scheduling and messages (MTB's) shall be controlled by the Get Main (GTMN) and Free Main (FRMN) subroutines. The MTB's shall be linked by EXINT with forward pointers to the next MTB to form a queue of available MTB's. GTMN uses the start of queue pointer (XSTR) to remove MTB's from the free queue. FRMN uses the end of queue pointer (XEND) to return MTB's to the free queue.

3.1.6    Executive Interprocessor Communication (EXIPR, EXIPS)

    EXIPR and EXIPS shall have the primary function of conducting all interprocessor communication between the resource, analysis, and classification processors.

    This process shall be accomplished in the following manner. A copy of EXIPR and EXIPS shall be resident in each of the above specified processors. Communication buffers shall be stablished in each of the common memories between processors. The buffers shall be segmented into message control blocks (MCB's). The MCB's shall be linked via a linked list.

    The MCB's are allocated upon demand with a get MCB request (call to GTMNC) and returned to free status via a free MCB request (call to FRMNC).

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3.1.6.1 <u>Interprocessor Communication Receiver (EXIPR)</u> - EXIPR shall determine whether there are any messages for transfer by checking the poll flags for each communication buffers. If there are no messages, i.e., the poll flags are clear - the routine returns. If there are messages to transfer (indicated by a non-zero poll):

1. The pointer to the first MCB shall be loaded.

2. The poll shall be decremented.

3. The message shall be processed by calling XMES.

4. The next link shall be examined. If the next link is not zero, the above steps shall be repeated until a zero link is encountered.

5. The MCB shall be returned to free storage (via a call to FRMNC).

3.1.6.2 <u>Interprocessor Communication Sender (EXIPS)</u> - EXIPS shall have the responsibility of directing messages from one of the three SC processors (RMP, CP, or AP) to either of the other two. EXIPS shall be driven by the Message/Processor Table (SMSPC). SMSPC shall have one 16-bit word entry for each Executive message type. The contents of each entry shall be used to decide to which processor the incoming message is to be sent. For example, in the RMP, a $\emptyset$-entry directs a message to the CP and 1-entry directs it to the AP.

After the destination processor has been selected, EXIPS shall request the allocation of the appropriate MCB and the message shall be copied into it. The poll is checked:

If zero: The pointer is loaded with the MCB's address. The poll is incremented by one.

If non-zero: The address of the current MCB is placed in the contents of the address indicated by the next link location. The poll is incremented.

Control is returned to the caller.

An example of one direction of the interprocessor communication algorithm is shown in Figure 3a.
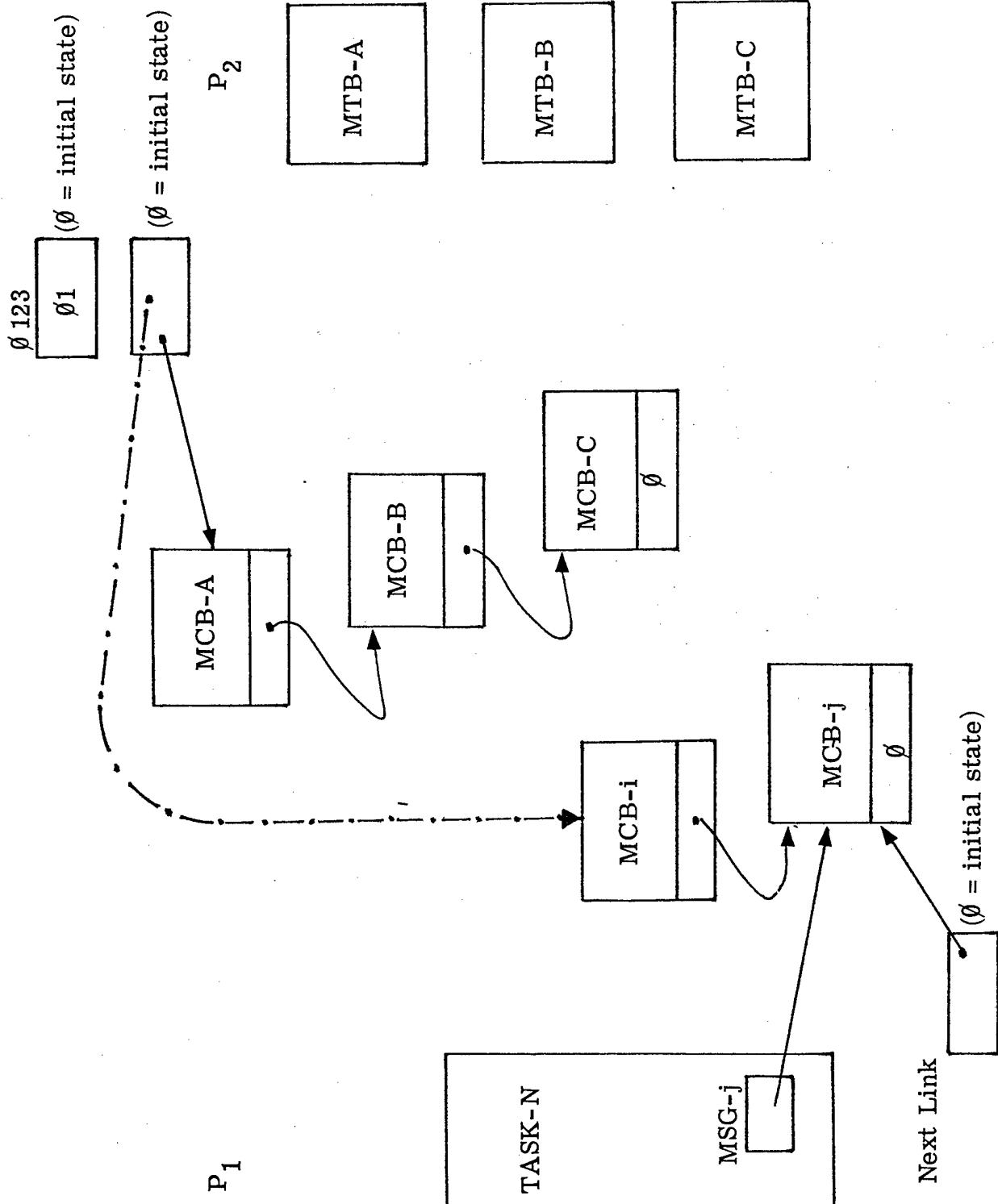
Figure 3a.    Interprocessor Communication Example

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3.1.6.3  MCB Management (GTMNC and FRMNC) -  The memory blocks used for interprocessor communication (MCB's) shall be controlled by the Get Main Common (GTMNC) and Free Main Common (FRMNC) subroutines. The three sets of MCB's (RMP/CP, RMP/AP, and CP/AP) shall be linked by EXINT (RMP EXINT, RMP EXINT, and CP EXINT, respectively) with forward pointers to the next MCB to form a queue of available MCB's. GTMNC uses the start of queue pointer (RCSTR, RASTR, and CASTR, respectively) to remove MCB's from one of the three free queues.  FRMNC uses the end of queue pointer (RCEND, RAEND, and CAEND, respectively) to return MCB's to one of the three free queues.

3.1.6.4  STE Message Sender (EXSTE) -  EXSTE shall be an RMP Exec routine called by XMES and shall have the responsibility of sending Executive message type 5's to the STE.  The messages shall be deposited into a circular buffer defined by the STE.

3.1.6.5  Signal Sorter Message Sender (EXSSS) -  EXSSS shall be a CP Exec routine called by XMES and shall have the responsibility of sending Executive message type 19's to the Signal Sorter.  The messages shall be deposited in either the high priority or low priority to - Sorter message buffers, depending on the message contents.  If the message is sent via the high priority buffer, the CP shall interrupt the Sorter when the message is to be transmitted.

3.2      SUBPROGRAM FLOW DIAGRAMS
         The following figures are the subprogram flow diagrams for the IEWS SC Executive function.

NOTUSD

```
        ( Start )
            |
   +-----------------+
   |   Get System    |
   |     Time        |
   +-----------------+
            |
   +-----------------+
   |  Put In Msg     |
   |    Buffer       |
   +-----------------+
            |
   +-----------------+            +-------------------+
   |  Output Error   |            | STE Opcodes       |
   |  Alert to STE   |- - - - - - |   RMP:  A1        |
   |  (EXMSG)        |            |   CP:   C1        |
   +-----------------+            |   AP:   E1        |
            |                     +-------------------+
        ( Halt )
```
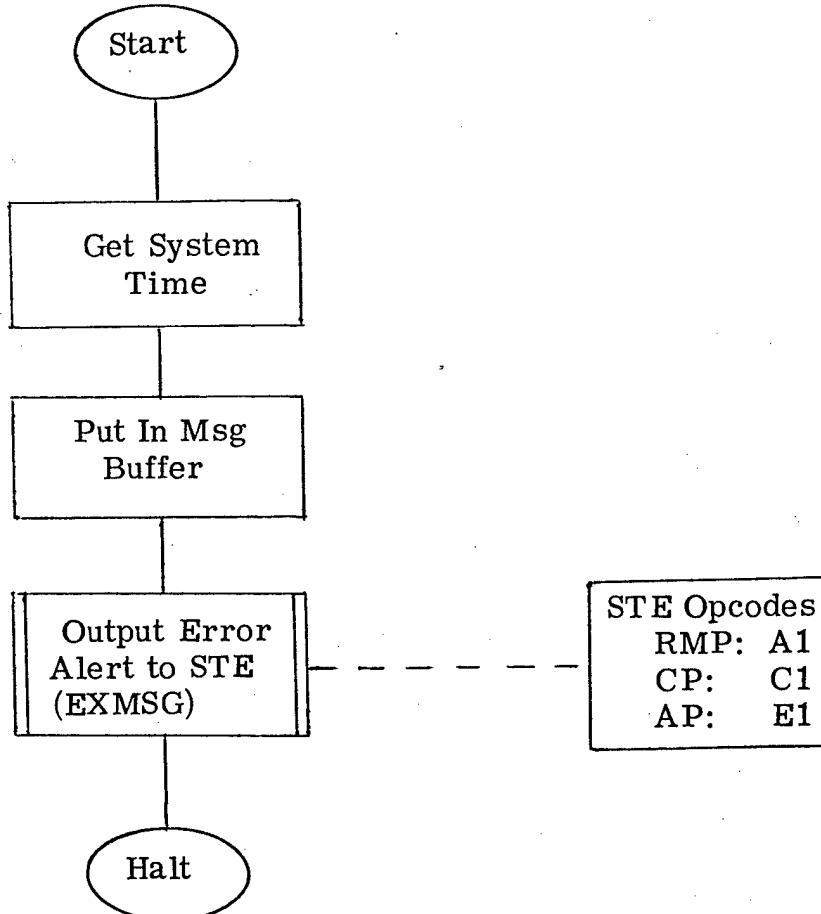
Routine:  Unexpected Interrupt Handler
Processors:  RMP, CP, AP

EXHNG

```
           ┌─────────┐
           │  Start  │
           └─────────┘
                │
        ┌───────────────┐
        │ Save A, E, B, │
        │    X, S, P    │
        │  Registers in │
        │  Msg  Buffer  │
        └───────────────┘
                │
        ┌───────────────┐
        │     Put       │
        │  System Time  │
        │  In Msg Buffer│
        └───────────────┘
                │
        ┌───────────────┐              ┌──────────────────┐
        │ Output Error  │              │  STE Opcodes     │
        │ Alert to STE  │ ─ ─ ─ ─ ─ ─  │   RMP:   AO      │
        │   (EXMSG)     │              │   CP:    CO      │
        └───────────────┘              │   AP:    EO      │
                │                      └──────────────────┘
           ┌─────────┐
           │  Halt   │
           └─────────┘
```
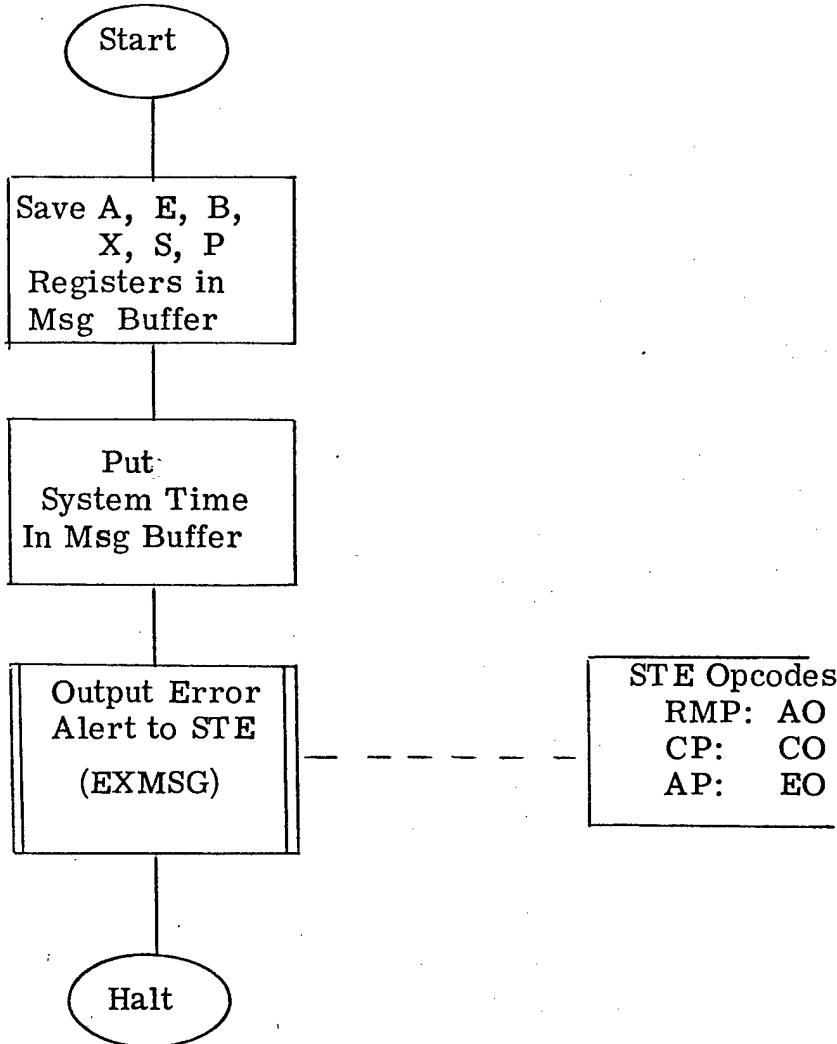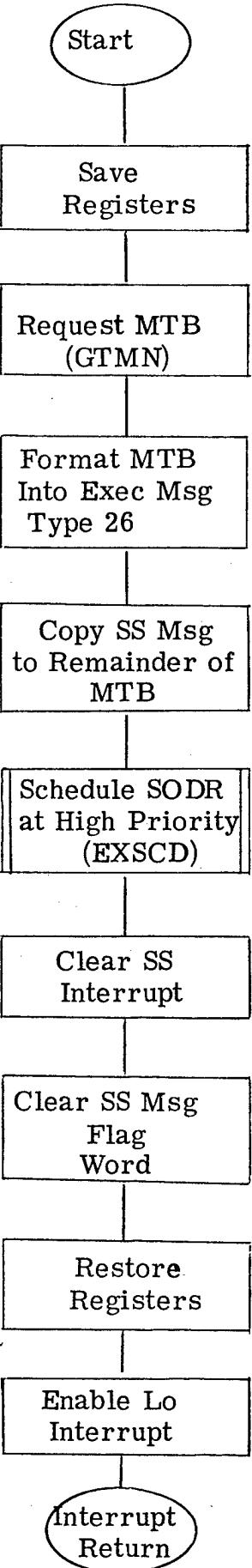
Routine:    Bus Hung Interrupt Handler
Processors:  RMP, CP, AP

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EXIH

```
        ( Start )
            |
    +---------------+
    |     Save      |
    |   Registers   |
    +---------------+
            |
    +---------------+
    |  Request MTB  |
    |    (GTMN)     |
    +---------------+
            |
    +---------------+
    |  Format MTB   |
    | Into Exec Msg |
    |    Type 26    |
    +---------------+
            |
    +---------------+
    |  Copy SS Msg  |
    | to Remainder of|
    |      MTB      |
    +---------------+
            |
    +---------------+
    | Schedule SODR |
    | at High Priority|
    |   (EXSCD)     |
    +---------------+
            |
    +---------------+
    |   Clear SS    |
    |   Interrupt   |
    +---------------+
            |
    +---------------+
    | Clear SS Msg  |
    |     Flag      |
    |     Word      |
    +---------------+
            |
    +---------------+
    |   Restore     |
    |  Registers    |
    +---------------+
            |
    +---------------+
    |  Enable Lo    |
    |  Interrupt    |
    +---------------+
            |
      ( Interrupt )
      (  Return   )
```

Routine:    Signal Sorter
            High Priority Message
            Interrupt Handler
Processor:  CP

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EXSPF

Start

Save
Registers

Put System
Time in Error
Alert Msg Buffer

Output
Error Alert
(XMES) ------- STE Op-code
is X'DØ'

Enable Lo
Interrupt

Restore
Registers
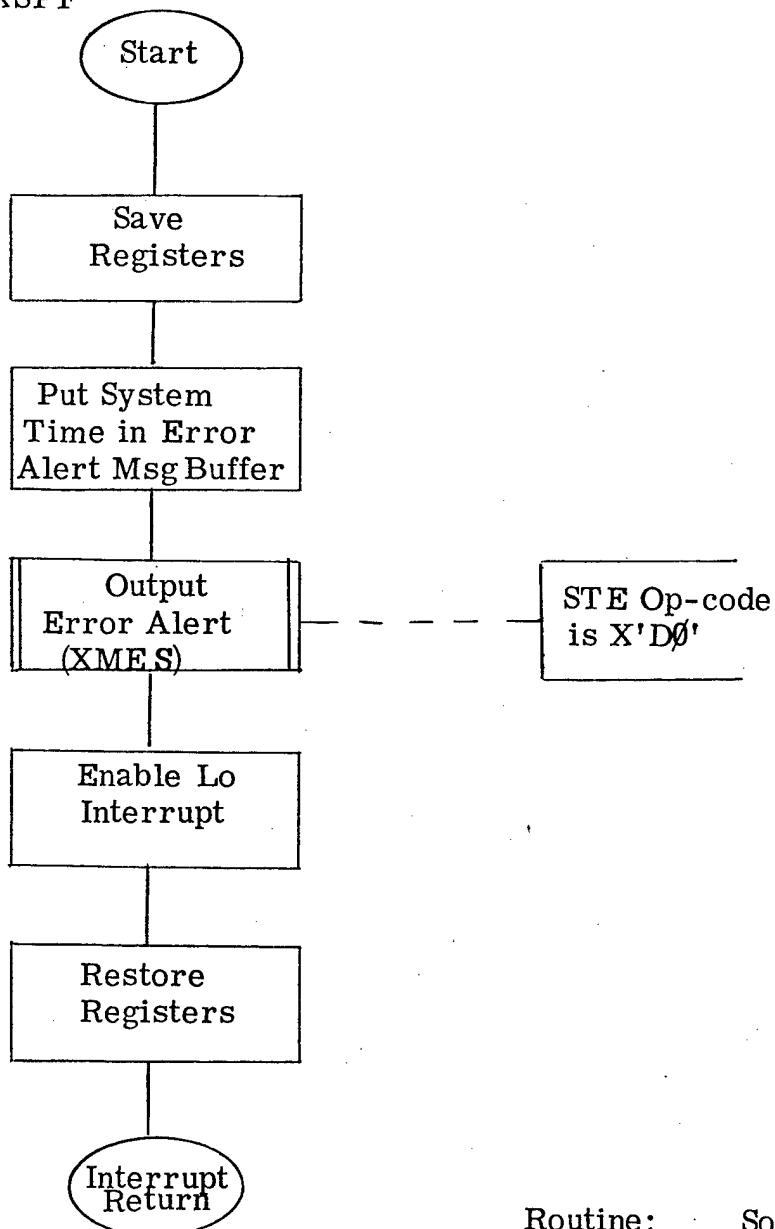
Interrupt
Return

Routine:     Sorter Power
             Fail Interrupt
             Handler
Processor:  CP

EXIH

```
        ┌─────────┐
        │  Start  │
        └────┬────┘
             │
      ┌──────┴──────┐
      │    Save     │
      │ A-Register  │
      └──────┬──────┘
             │
      ┌──────┴───────┐          ┌──────────────────────┐
      │  Read ABI    │          │ Bit 15 = Bus Hung    │
      │Interrupt Status├ ─ ─ ─ ─ ┤                      │
      │    Word      │          │ Bit 14 = Data Service │
      └──────┬───────┘          └──────────────────────┘
             │
           ◇─┴─◇        Y    ┌─────────────┐      ╭──────────╮
         Bus Hung? ──────────│  Restore    │──────│ Jump to  │
           ◇───◇             │ A-Register  │      │  EXHNG   │
             │               └─────────────┘      ╰──────────╯
             │
           ◇─┴─◇        Y                          ╭──────────╮
          Data   ────────────────────────────────│ Jump to  │
         Service?                                  │  EXBF    │
           ◇───◇                                   ╰──────────╯
             │
        ╭────┴────╮
        │ Jump to │
        │ NOTUSD  │
        ╰─────────╯
```
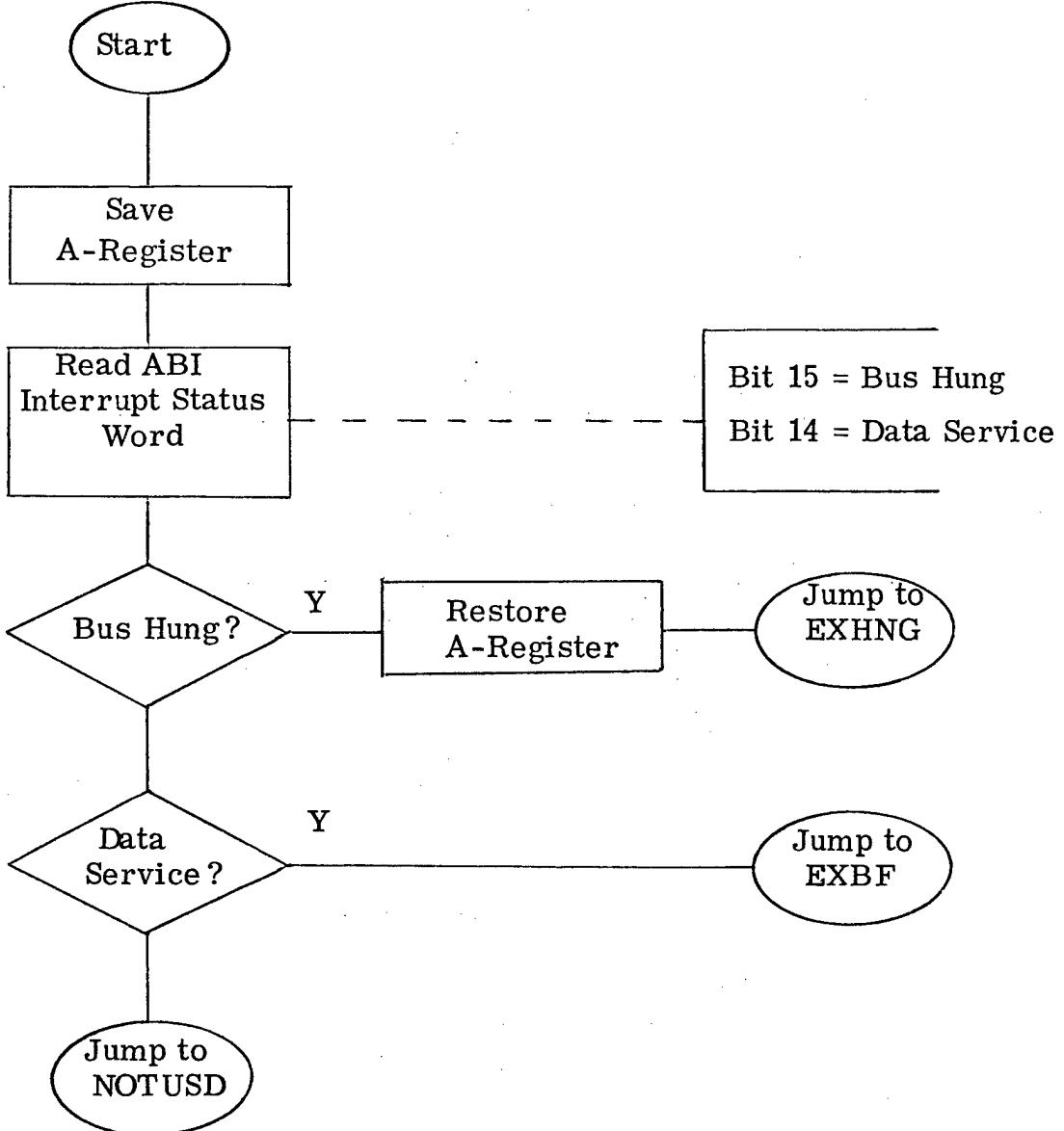
Routine:      Low Level
              Interrupt Handler
Processor:    AP

EXBF

```
           ( Start )
              |
   +---------------------+       +--------------------+
   |   Save B, E, X      | ----- |  A-Reg saved by    |
   |    Registers        |       |  AP's EXIH         |
   +---------------------+       +--------------------+
              |
   +---------------------+
   |   Call Buffer       |
   | Full Processing     |
   |    (ABFUL)          |
   +---------------------+
              |
   +---------------------+
   |   Restore All       |
   |    Registers        |
   +---------------------+
              |
   +---------------------+
   |    Enable Lo        |
   |    Interrupts       |
   +---------------------+
              |
          ( Interrupt
             Return )
```
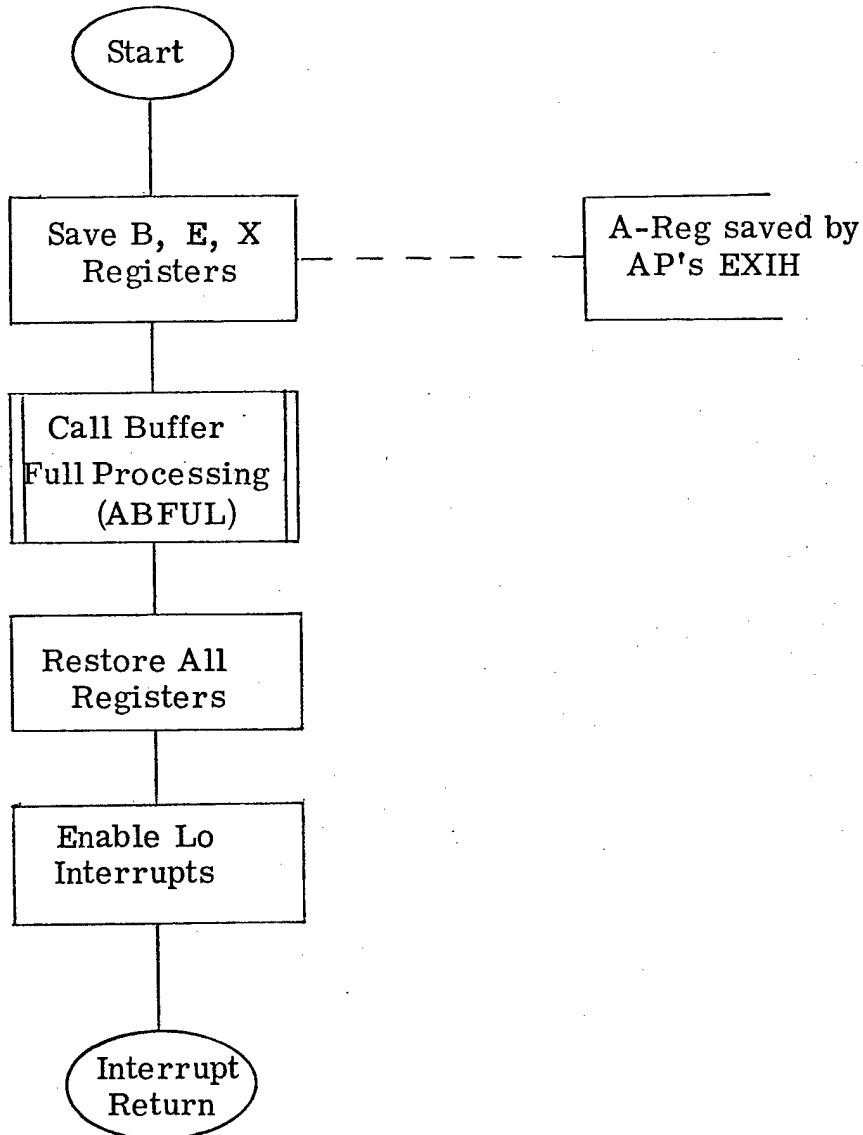
Routine:     ABI Data Buffer
             Full Interrupt
             Handler
Processors:  AP

EXTIM

**Start**

Real time clock interrupt
occurs every 2 msec

Save Registers

Read ET
Status

= 0 ?  —— Y ——  (A. 1)

N

Save Status in
Exec Msg Type
21 Msg Buffer

Output Msg
(EXMSG)

(A. 1)
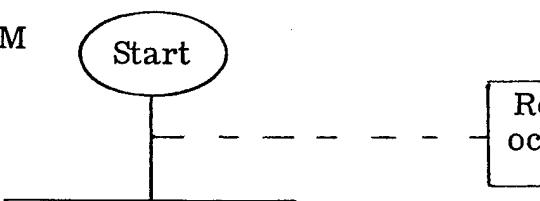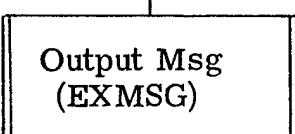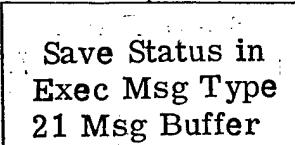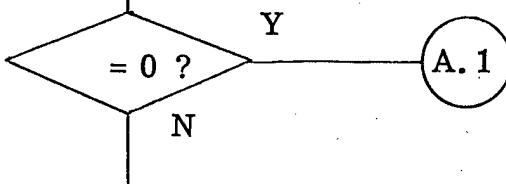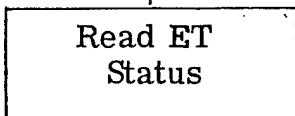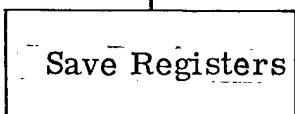
Routine: Real Time Clock
Interrupt Handler

Processor: RMP

1 of 4
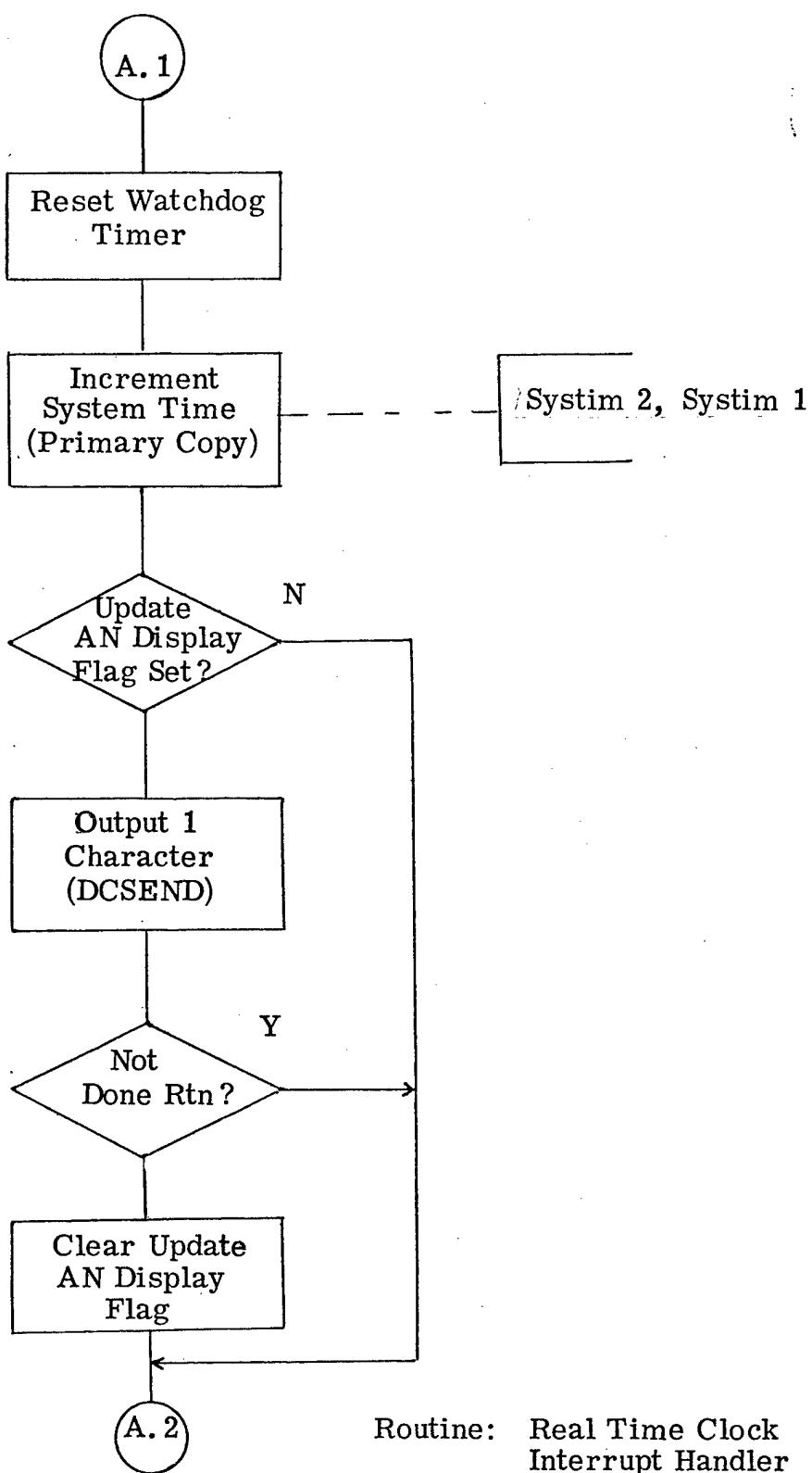
```
                    ( A. 1 )
                       │
          ┌─────────────────────────┐
          │     Reset Watchdog      │
          │         Timer           │
          └─────────────────────────┘
                       │
          ┌─────────────────────────┐           ┌─────────────────────────┐
          │        Increment        │ ─ ─ ─ ─ ─ │  Systim 2, Systim 1     │
          │      System Time        │           │                         │
          │     (Primary Copy)      │           └─────────────────────────┘
          └─────────────────────────┘
                       │
                      ╱ ╲          N
                     ╱   ╲──────────────┐
                    ╱Update╲            │
                    ╲AN Display         │
                     ╲Flag Set?╱        │
                      ╲   ╱             │
                       ╲ ╱              │
                        │ Y            │
          ┌─────────────────────────┐  │
          │        Output 1         │  │
          │       Character         │  │
          │       (DCSEND)          │  │
          └─────────────────────────┘  │
                       │               │
                      ╱ ╲       Y      │
                     ╱   ╲─────────────┼──────►
                    ╱ Not ╲            │
                    ╲Done Rtn?╱        │
                     ╲     ╱           │
                      ╲   ╱            │
                       ╲ ╱             │
                        │              │
          ┌─────────────────────────┐ │
          │     Clear Update        │ │
          │     AN Display          │ │
          │        Flag             │ │
          └─────────────────────────┘ │
                       │◄─────────────┘
                    ( A. 2 )
```

Routine:   Real Time Clock
           Interrupt Handler

Processors: RMP

2 of 4

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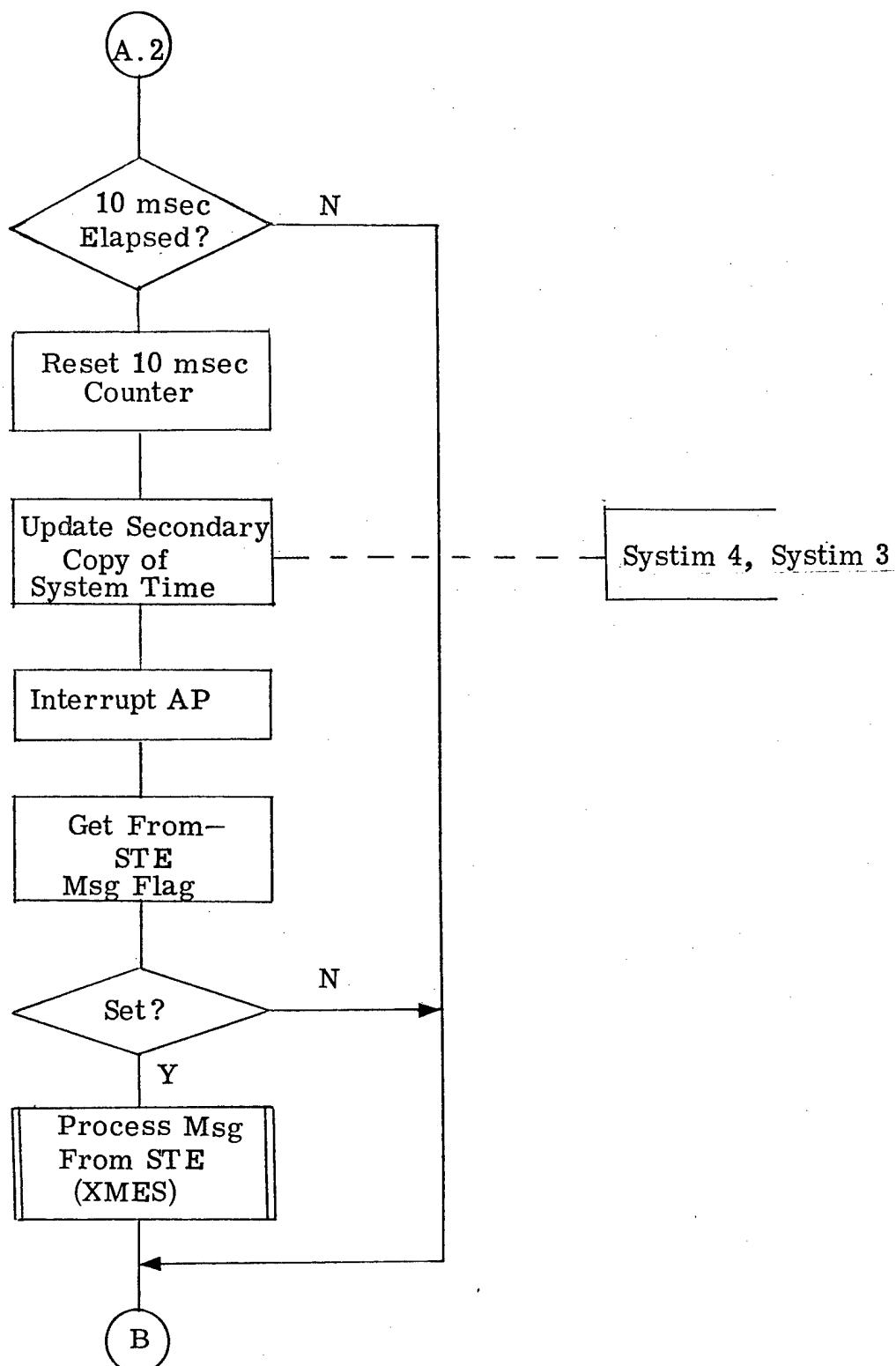
| CODE IDENT NO. | SPEC NO. |
|---|---|
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(A.2)

10 msec Elapsed? — N →

Reset 10 msec Counter

Update Secondary Copy of System Time ——— Systim 4, Systim 3

Interrupt AP

Get From— STE Msg Flag

Set? — N →

Y

Process Msg From STE (XMES)

(B)

Routine: Real Time Clock Interrupt Handler

Processors: RMP

3 of 4

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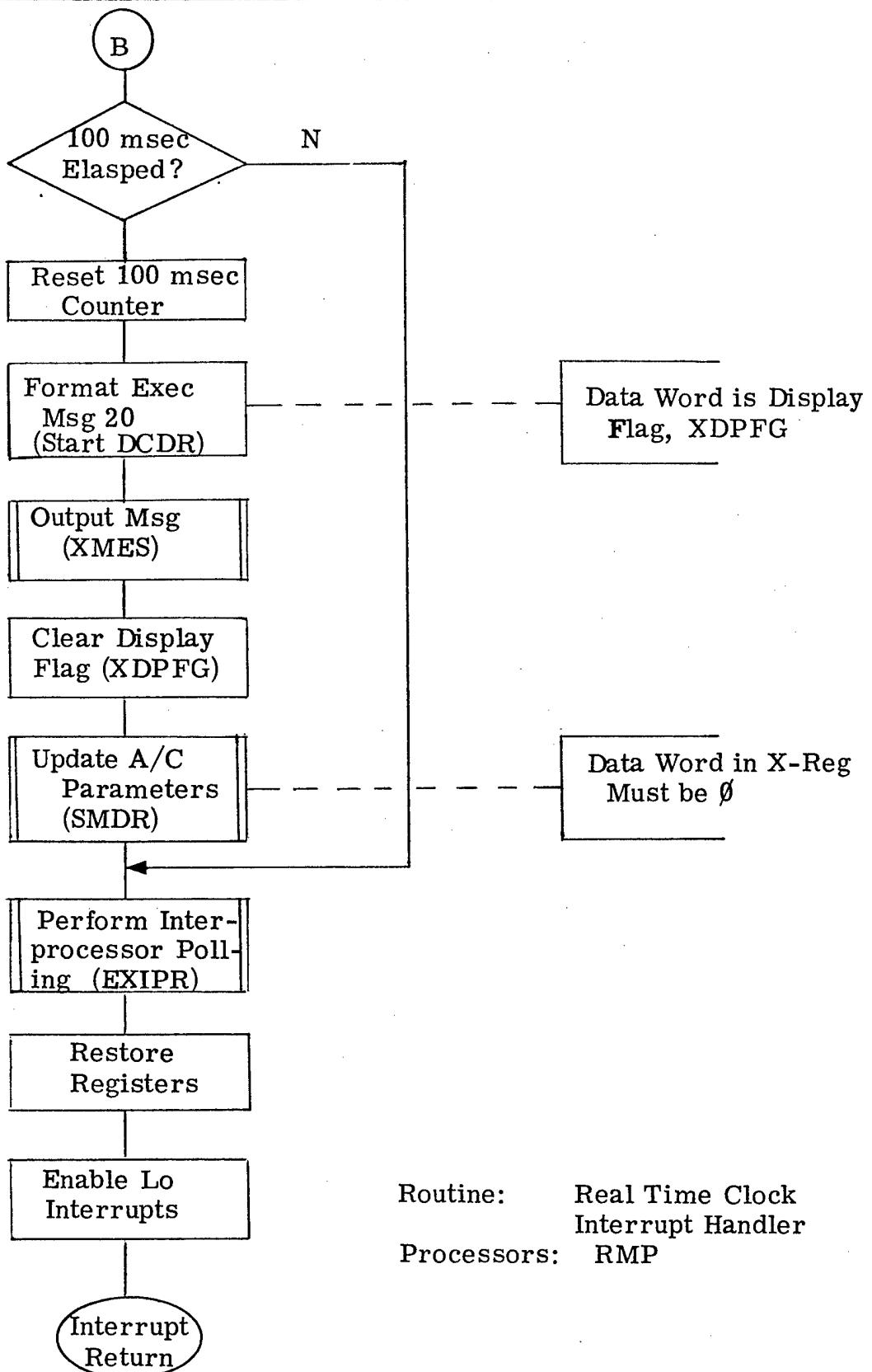
CODE IDENT NO.
49956

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REV A

(B)

100 msec
Elasped?  — N

Reset 100 msec
Counter

Format Exec
Msg 20
(Start DCDR)  – – – – – – – Data Word is Display
Flag, XDPFG

Output Msg
(XMES)

Clear Display
Flag (XDPFG)

Update A/C
Parameters
(SMDR)  – – – – – – – Data Word in X-Reg
Must be $\emptyset$

Perform Inter-
processor Poll-
ing (EXIPR)

Restore
Registers

Enable Lo
Interrupts

Routine:     Real Time Clock
Interrupt Handler
Processors:  RMP

Interrupt
Return

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**RAYTHEON**

EXTIM

( Start )

- - - - - - - - - - - - - - - Real Time Clock Interrupt
Occurs Every 2 msec.

Save Registers

Get SS Lo-
Priority Msg
Flag

Set ? — N

Y

Request MTB
(GTMN)

Format MTB
into Exec Msg
Type 26

Copy SS Msg to
Reminder of
MTB

Schedule SODR
at Lo-Priority
(EXSCD)

Perform
Interprocessor
Polling
(EXIPR)

Restore
Registers

Enable Lo
Interrupts

( Interrupt
Return )

Routine:  Real Time Clock
Interrupt Handler

Processors:  CP

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REV A

EXTIM

**Start**

Interrupt from RMP
Occurs Every 10 msec

Save
Registers

50 msec
Elapsed?      N

Y

Reset 50 msec
Counter

Set 50 msec
Elapsed Flag

Restore
Registers

Enable Hi
Interrupts

Interrupt
Return

Routine:      Simulated Real
Time Clock
Interrupt Handler
(RMP Interrupt)

Processors:   AP

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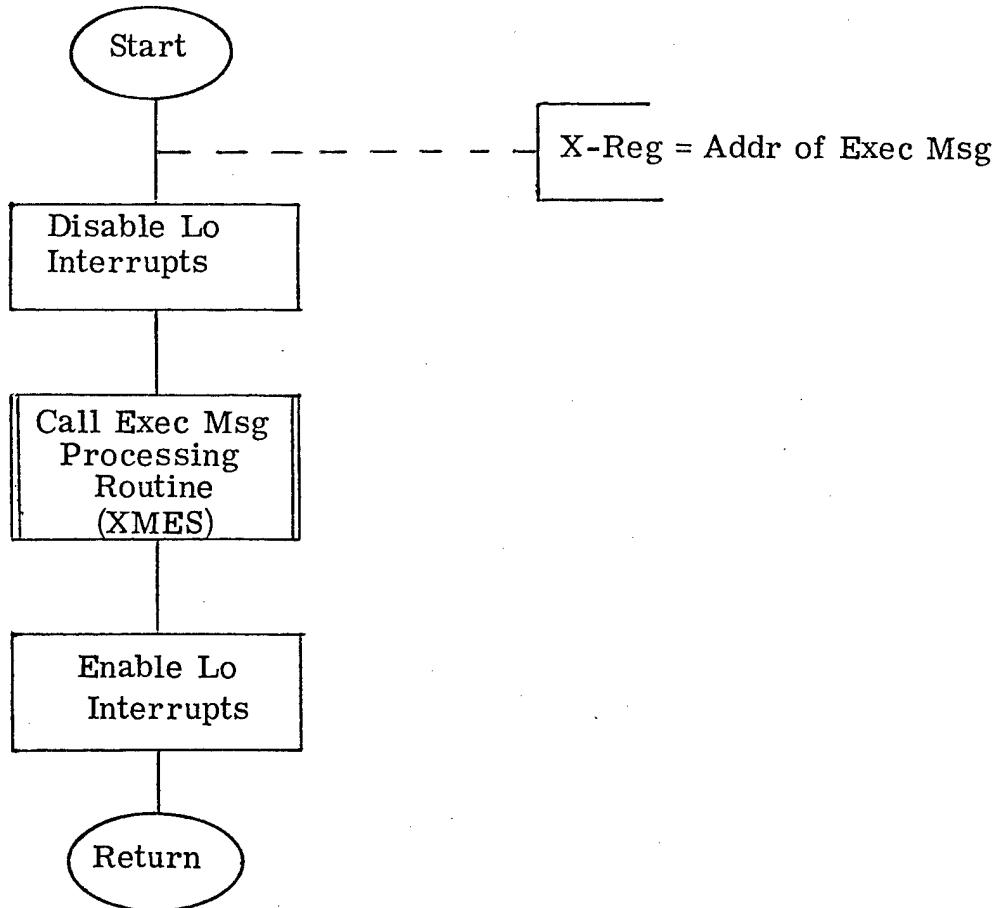
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EXMES
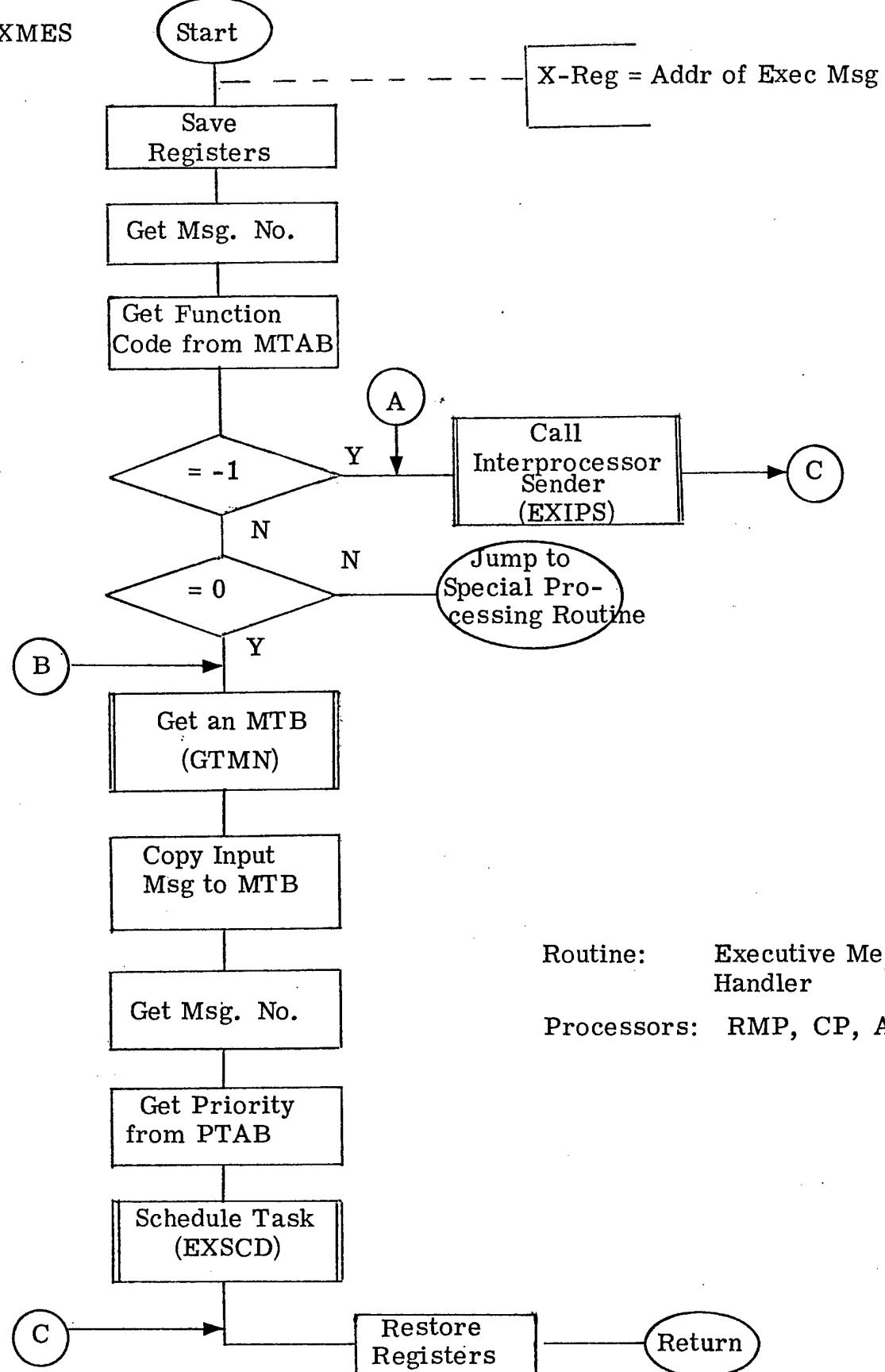
```
              ( Start )
                  |
                  | - - - - - - - -| X-Reg = Addr of Exec Msg
                  |
        +--------------------+
        |    Disable Lo      |
        |    Interrupts      |
        +--------------------+
                  |
        +--------------------+
        |   Call Exec Msg    |
        |    Processing      |
        |     Routine        |
        |     (XMES)         |
        +--------------------+
                  |
        +--------------------+
        |    Enable Lo       |
        |    Interrupts      |
        +--------------------+
                  |
              ( Return )
```

Routine:     Executive Message
             Handler

Processors:  RMP, CP, AP

XMES

Start

— — — — — — — — X-Reg = Addr of Exec Msg

Save Registers

Get Msg. No.

Get Function Code from MTAB

(A)

= -1 → Y → Call Interprocessor Sender (EXIPS) → (C)

N

= 0 → N → Jump to Special Processing Routine

Y

(B) →

Get an MTB (GTMN)

Copy Input Msg to MTB

Get Msg. No.

Get Priority from PTAB

Schedule Task (EXSCD)

Routine:     Executive Message Handler

Processors:  RMP, CP, AP

(C) → Restore Registers → Return

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CODE IDENT NO. 49956
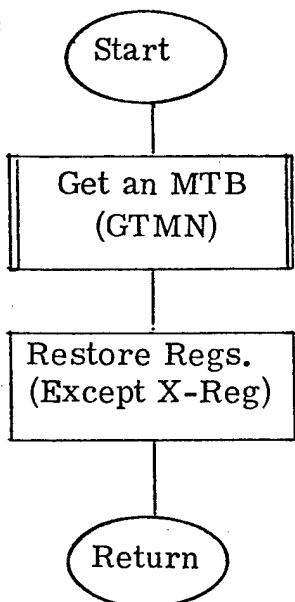
SPEC NO. 53959-GT-0756

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MSG 24
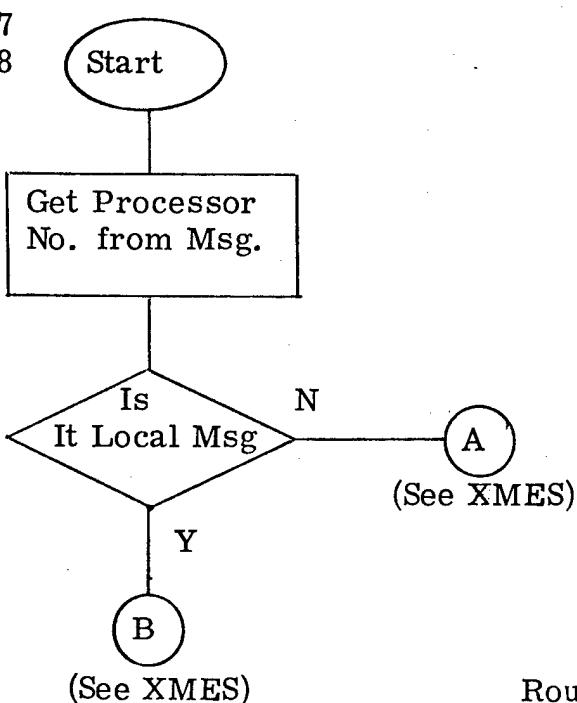
Start

Get an MTB
(GTMN)

Restore Regs.
(Except X-Reg)

Return

MSG 25

Start

Get Addr of MTB
from Input Msg

Return 1 MTB
(FRMN)

C

(See XMES)

MSG 27
MSG 28

Start

Get Processor
No. from Msg.

Is
It Local Msg — N → A
(See XMES)

Y

B

(See XMES)

Routine:    Executive Message
Handler Special
Processing

Processors:  RMP, CP, AP

MSG 18

Start

Set Alphanumeric
Update
Flag

C

(See XMES)

MSG 5

Start

Call STE
Sender
(EXSTE)

C

(See XMES)

MSG 20

Start

Set Display
Flag

B

(See XMES)
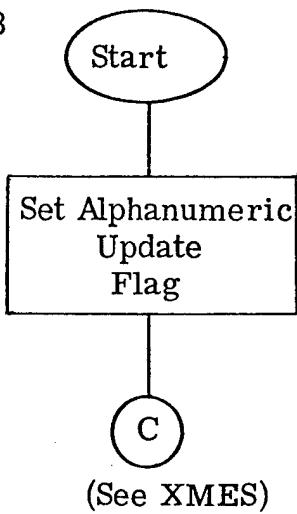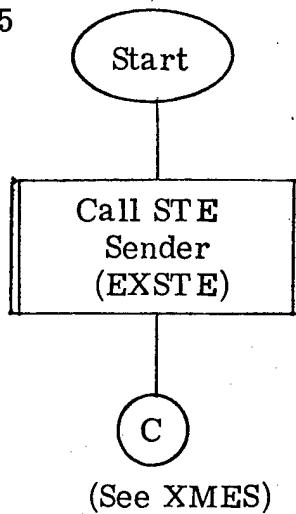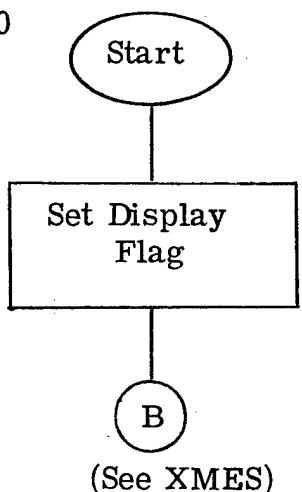
Routine:   Executive Message
Handler Special
Processing

Processors:  RMP

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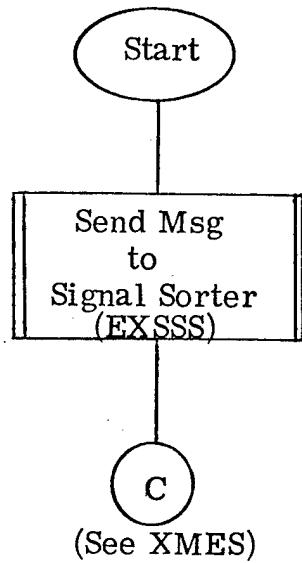
CODE IDENT NO.
49956

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REV A

MSG 19

Start

Send Msg
to
Signal Sorter
(EXSSS)

C

(See XMES)

Routine:  Executive Message
Handler Special
Processing

Processors:  CP

EXSTE

Start

X-Reg = Addr of Exec
Msg Type 5

Get Next
Store Addr

New Next Store
= Next Store
+19

New
Next Store
< End of
Buffer

Y

N

New Next Store
= Start of Buffer

New
Next Store
= Next Read

N

Copy Msg to
Circular Buffer

Next Store ⟵
New Next Store
Value

Return
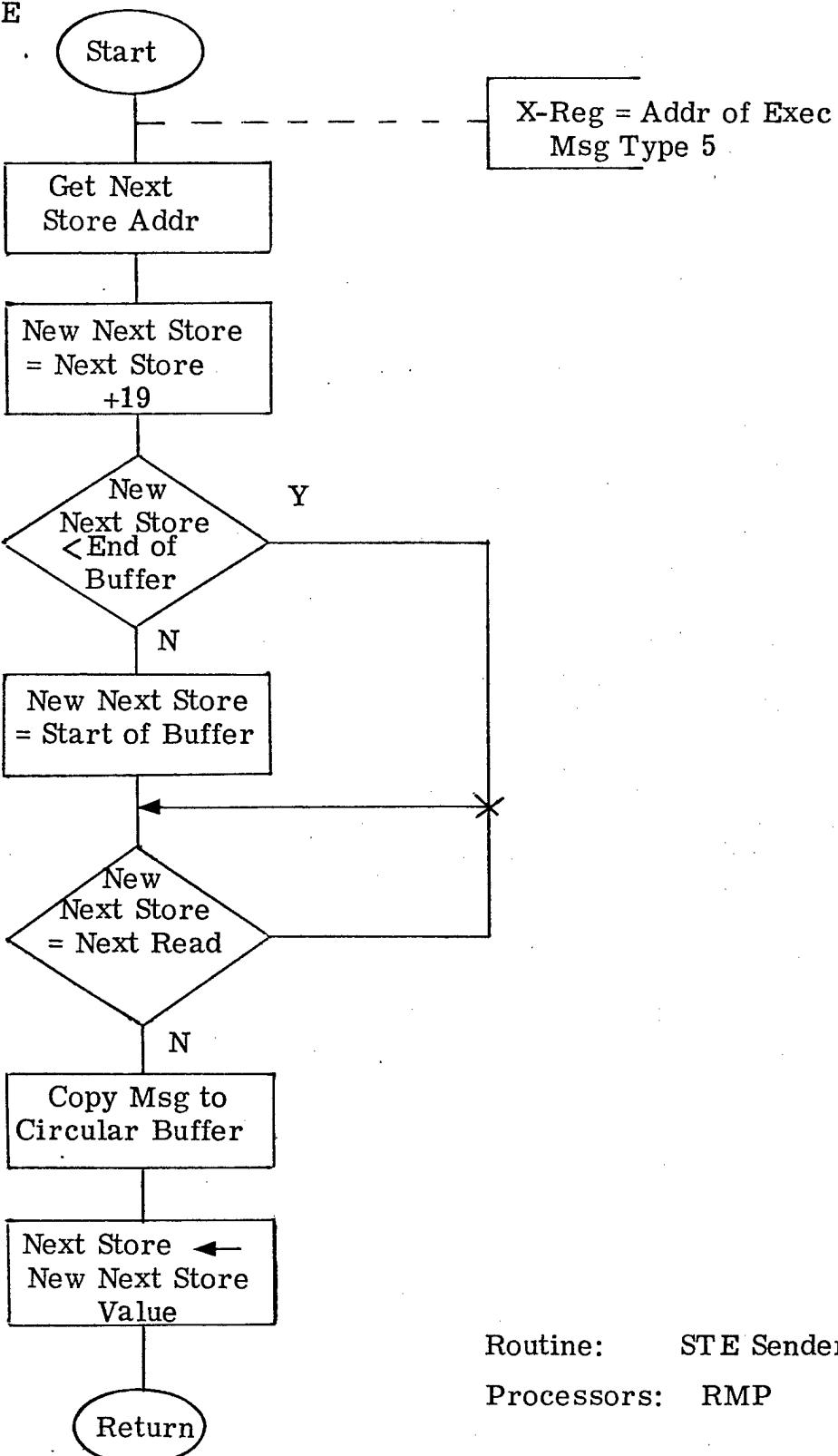
Routine:      STE Sender

Processors:   RMP

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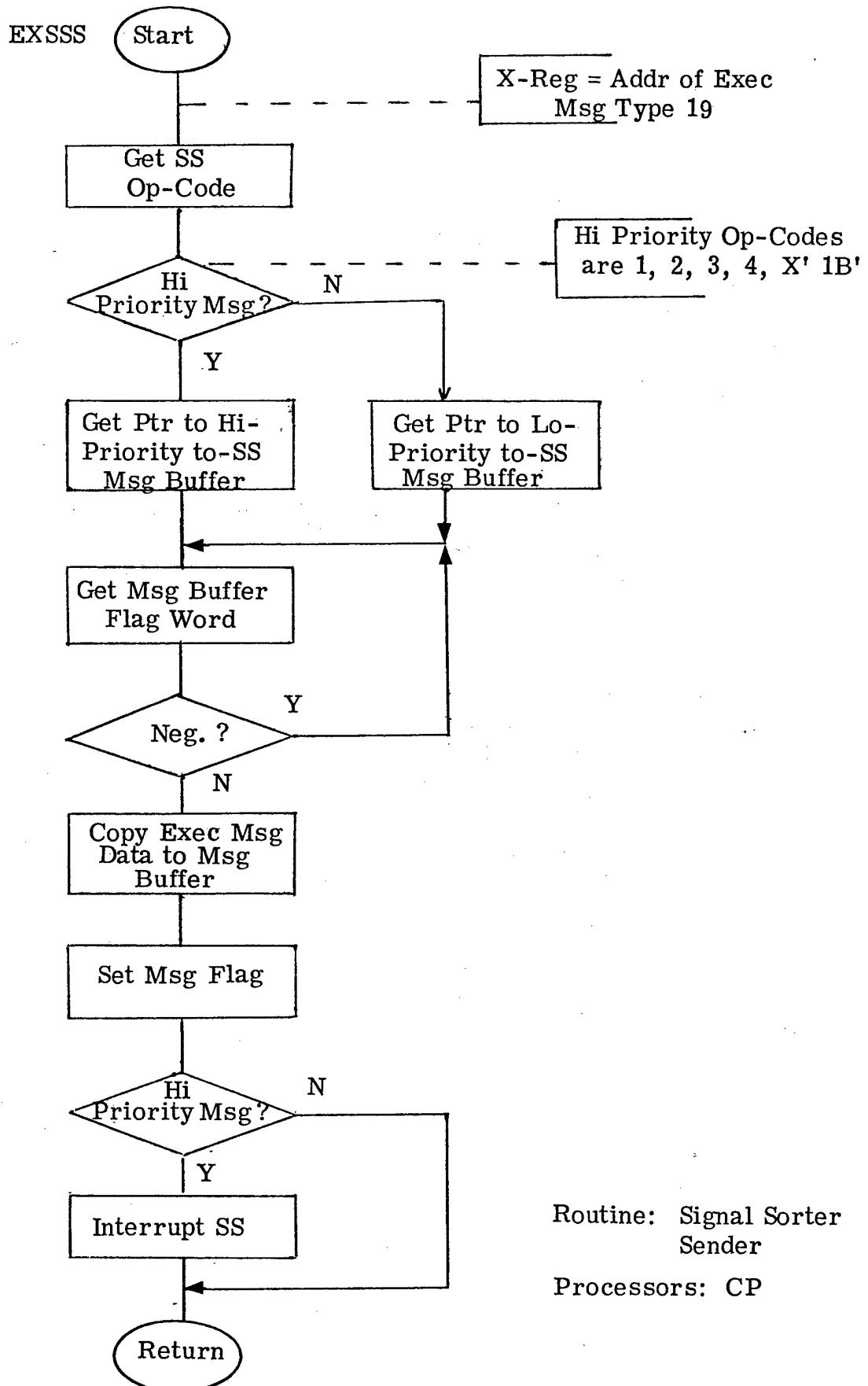
CODE IDENT NO. 49956

SPEC NO. 53959-GT-0756

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EXSSS ( Start )

X-Reg = Addr of Exec
Msg Type 19

Get SS
Op-Code

Hi Priority Op-Codes
are 1, 2, 3, 4, X' 1B'

Hi Priority Msg? — N

Y

Get Ptr to Hi-
Priority to-SS
Msg Buffer

Get Ptr to Lo-
Priority to-SS
Msg Buffer

Get Msg Buffer
Flag Word

Neg. ? — Y

N

Copy Exec Msg
Data to Msg
Buffer

Set Msg Flag

Hi Priority Msg? — N

Y

Interrupt SS

Routine: Signal Sorter
Sender

Processors: CP

( Return )

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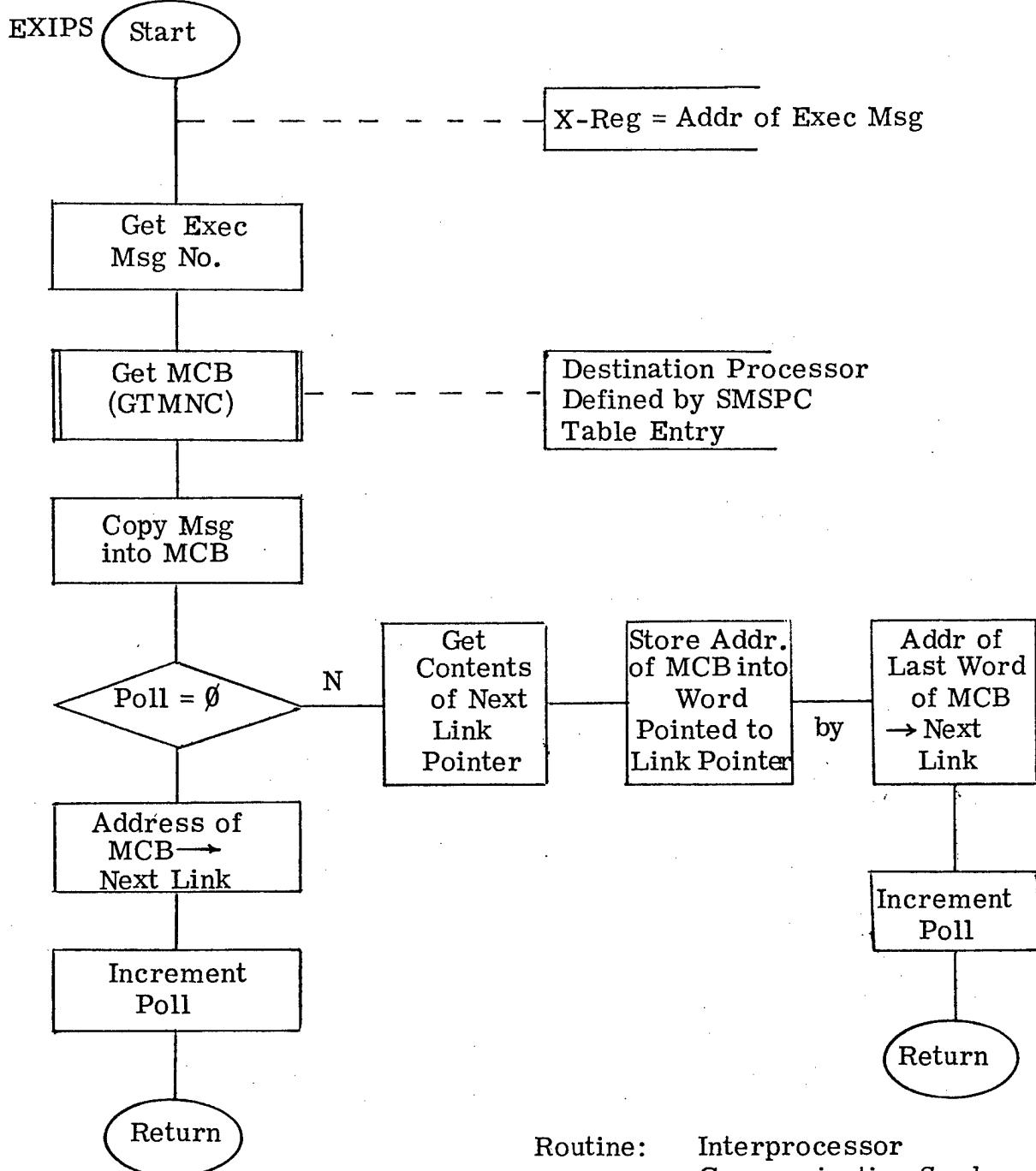
CODE IDENT NO. 49956

SPEC NO. 53959-GT-0756

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REV A

EXIPS  ( Start )

- - - - - - - - - | X-Reg = Addr of Exec Msg |

| Get Exec Msg No. |

| Get MCB (GTMNC) | - - - - - - - | Destination Processor Defined by SMSPC Table Entry |

| Copy Msg into MCB |

$\langle$ Poll = $\emptyset$ $\rangle$ — N → | Get Contents of Next Link Pointer | — | Store Addr. of MCB into Word Pointed to Link Pointer | — by — | Addr of Last Word of MCB → Next Link |

| Address of MCB → Next Link |

| Increment Poll |  (right branch) | Increment Poll |

( Return )   ( Return )

Routine:    Interprocessor Communication Sender

Processors:  RMP, CP, AP

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REV A

EXIPR

Start

Set Processor
Index to ∅

- - - - RMP polls CP, AP
CP polls RMP, AP
AP polls RMP, CP

B

A

Increment
Index

= 2

N → B

Y

Return

Routine: Interprocessor
Communication Receiver

Processors: RMP, CP, AP

(1 of 2)

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REV A

B

Get Indexed
Pointer to MCB

Get Indexed
Memory Addr.
Offset

Add Offset
to Addr of MCB

Decrement
Indexed Poll

Process the
Message
(XMES)

Return MCB
to Free Block
Pool (FRMNC)

Was
Link Word of
MCB=0 —Y— A

No

Routine: Interprocessor
Communication
Receiver

Processors: RMP, CP, AP

(2 of 2)

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REV A

EXSCD

( Start )

B-Reg = Priority = 0, 1
X-Reg = Addr of MTB

```
Save Regs
```

```
Clear Word 22
of MTB          (fwd ptr)
```

```
Swap Addr With
Indexed EOQ Ptr  — — — — — —   Index is the
                                Priority
```

Was EOQ = 0  —— Y ——  Save Addr
                        in Indexed
                        SOQ  Ptr

N

```
Set Previous
Last Entry
fwd ptr = to Addr
```

```
Restore Regs
```

( Subr
Return )
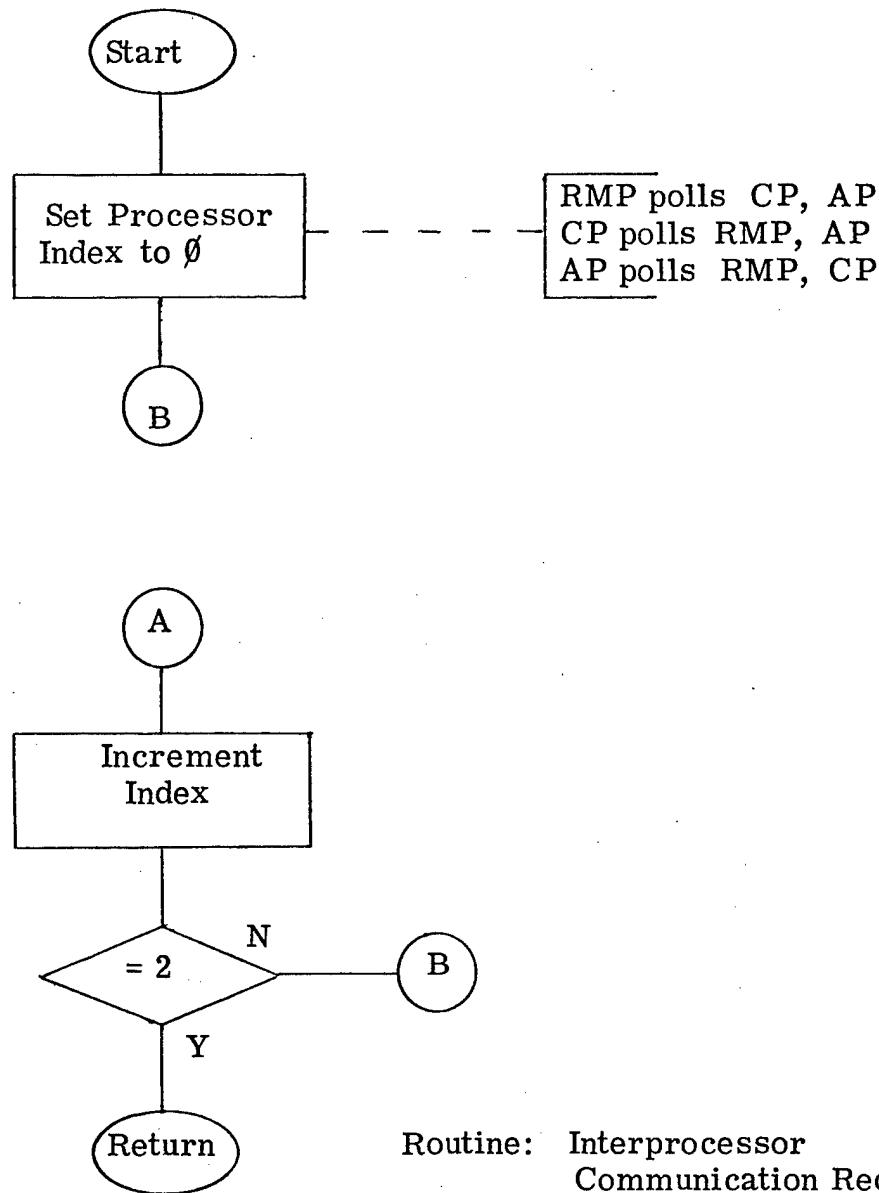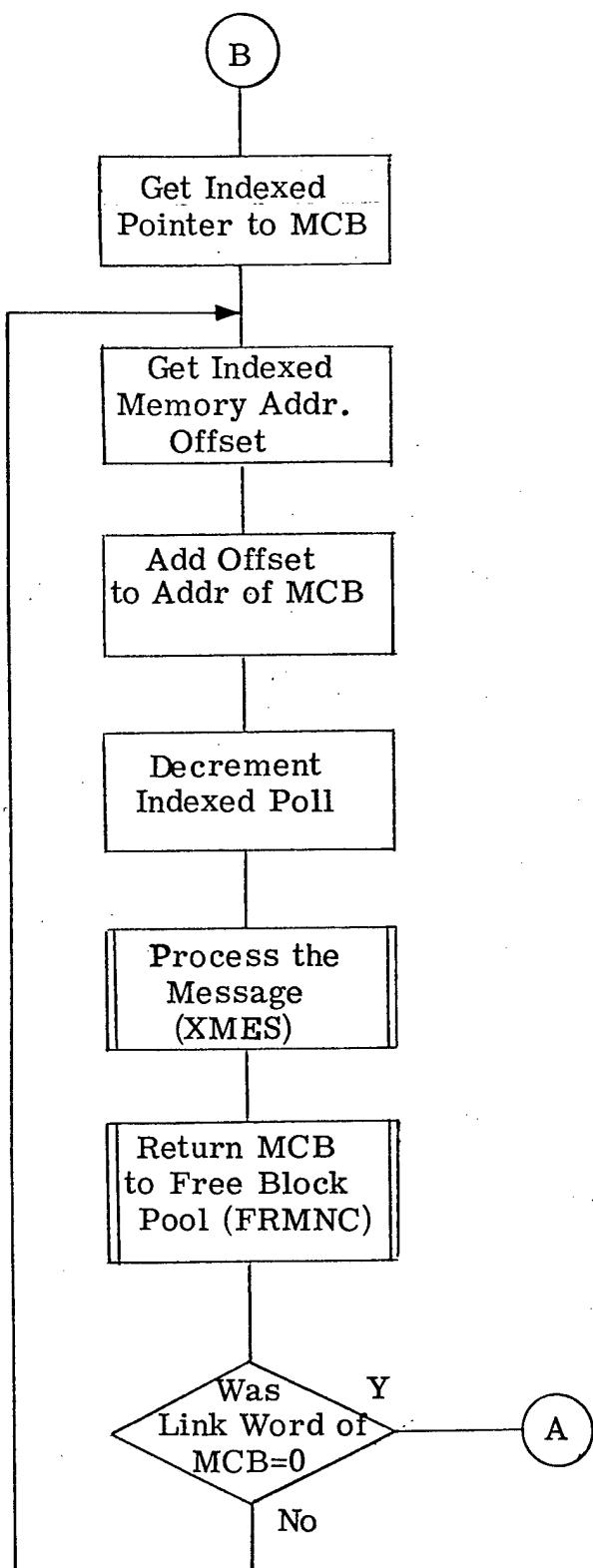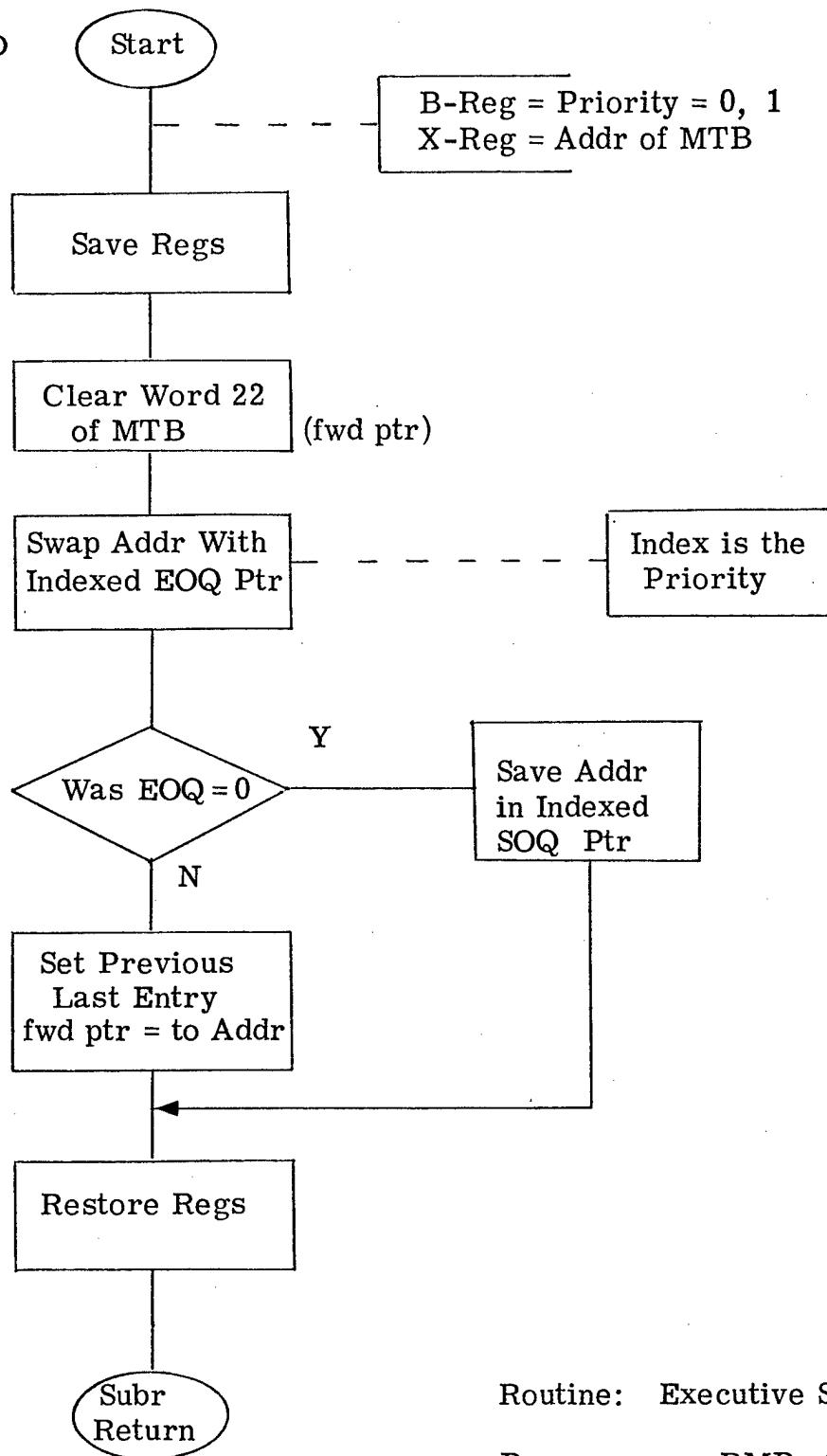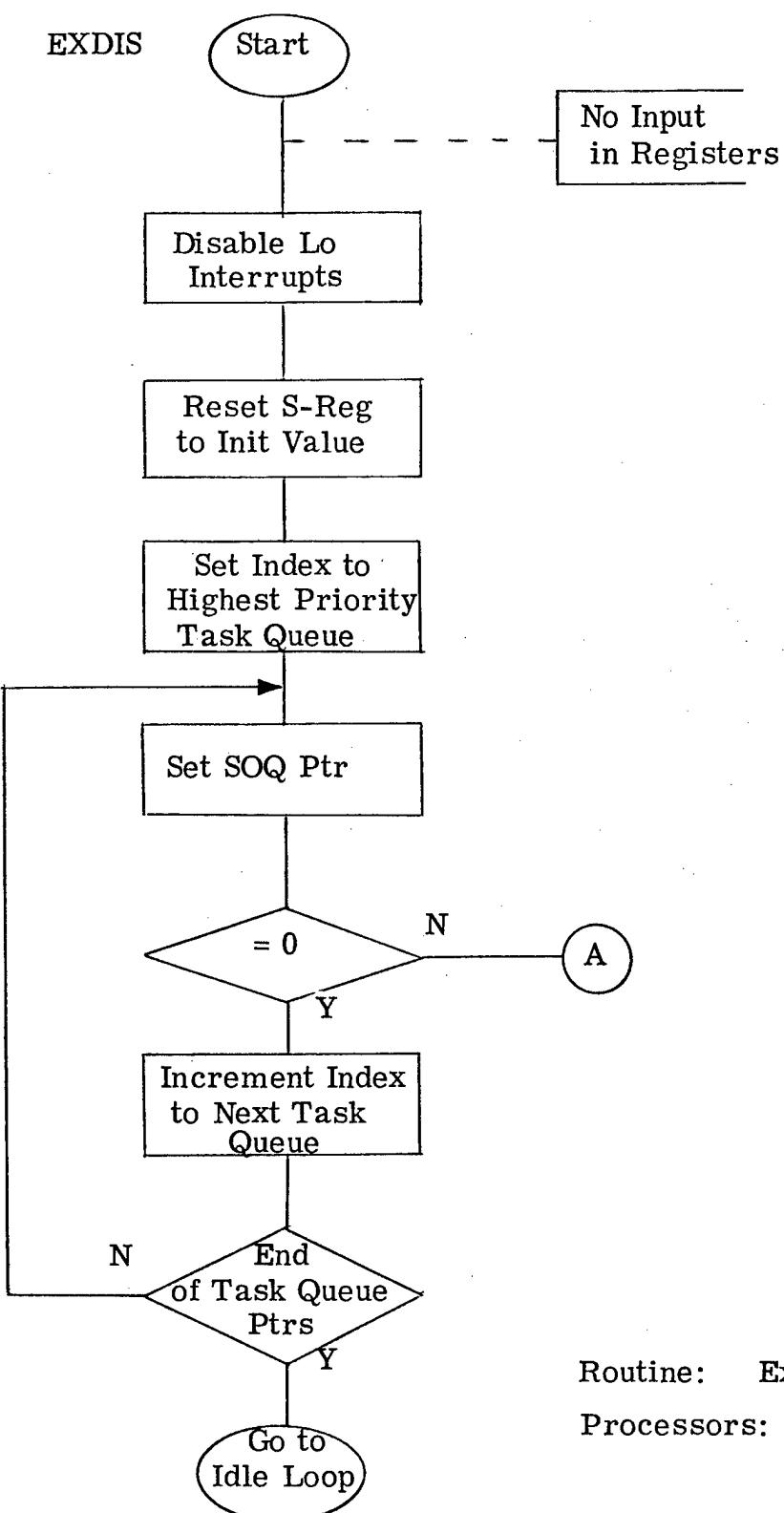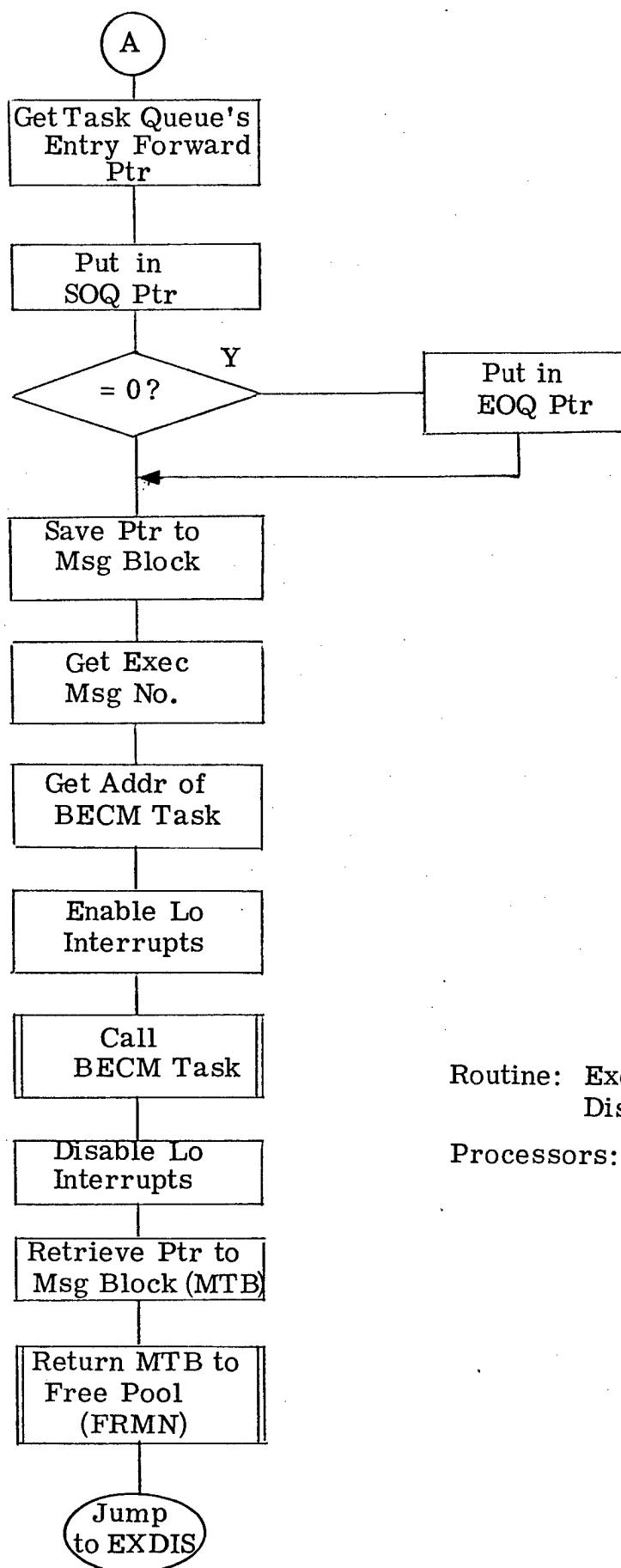
Routine:   Executive Scheduler

Processors:  RMP, CP, AP

EXDIS

Start

No Input
in Registers

Disable Lo
Interrupts

Reset S-Reg
to Init Value

Set Index to
Highest Priority
Task Queue

Set SOQ Ptr

= 0 — N → A

Y

Increment Index
to Next Task
Queue

N — End
of Task Queue
Ptrs

Y

Go to
Idle Loop

Routine: Executive Dispatcher

Processors: RMP, CP

(1 of 2)

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REV A

( A )

Get Task Queue's
Entry Forward
Ptr

Put in
SOQ Ptr

= 0 ? ──Y──→ Put in
EOQ Ptr

Save Ptr to
Msg Block

Get Exec
Msg No.

Get Addr of
BECM Task

Enable Lo
Interrupts

Call
BECM Task

Disable Lo
Interrupts

Retrieve Ptr to
Msg Block (MTB)

Return MTB to
Free Pool
(FRMN)

Jump
to EXDIS

Routine:  Executive
Dispatcher

Processors: RMP, CP

(2 of 2)

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REV A

EXDS 80

( Start )

```
+------------------+
|   Enable Lo      |
|   Interrupts     |
+------------------+
```

```
+------------------+
|                  |
|      Nop         |
|                  |
+------------------+
```

( Jump
to EXDIS )

Routine:      Executive Dispatcher
              Idle Loop

Processors:   RMP

EXDS 80 ( Start )

Enable Lo
Interrupts

Get SS Lo
Priority Flag

Neg? — N

Y

Disable Lo
Interrupts

Get an MTB
(GTMN)

Copy SS Msg
to MTB

Clear SS Lo
Priority Flag

Schedule BECM
Task
(EXSCD)

( Jump
to EXDIS )

Routine:  Executive Dispatcher
Idle Loop

Processors: CP

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CODE IDENT NO.
49956
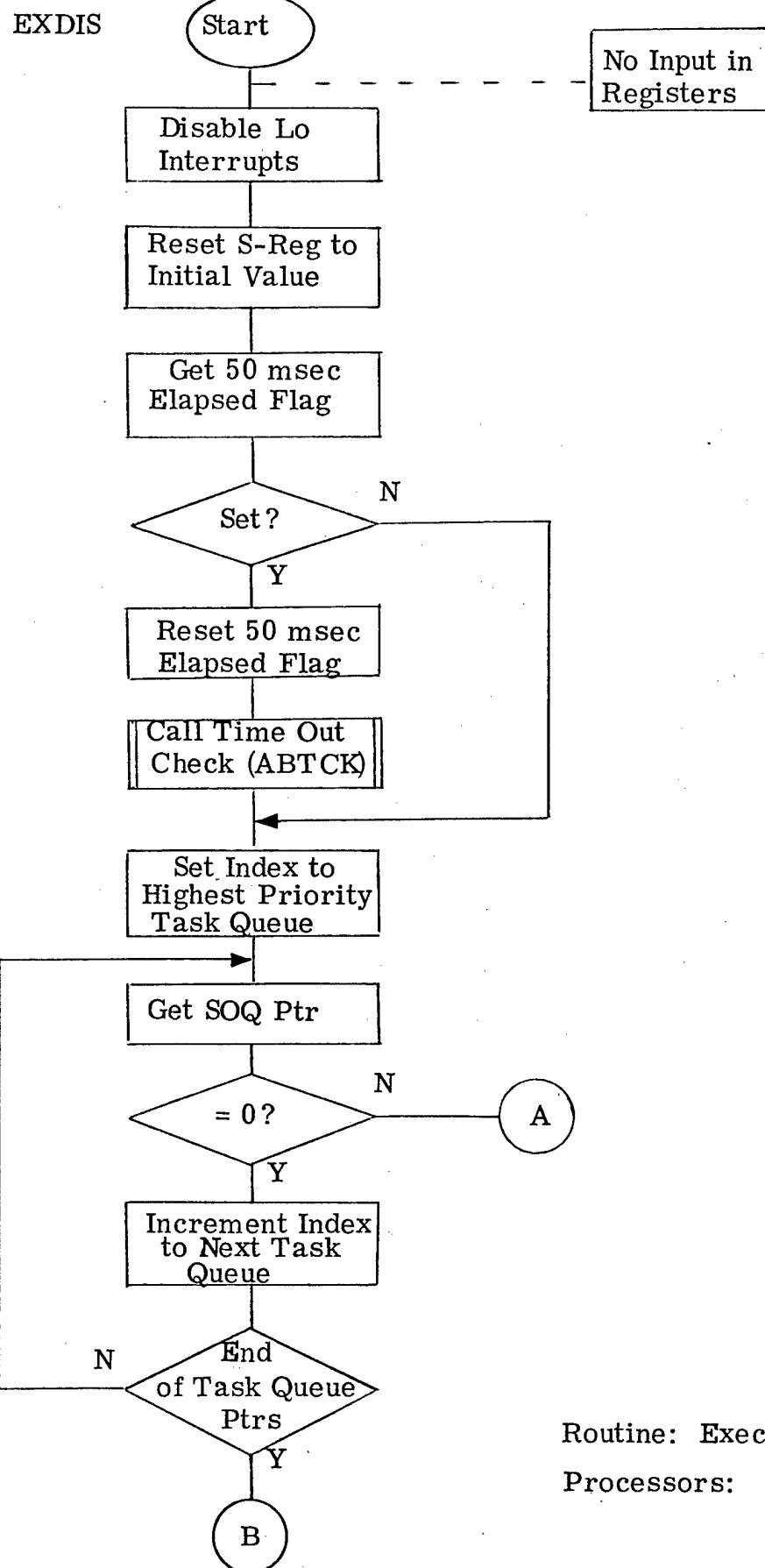
SPEC NO.
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SHEET
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REV A

EXDIS

Start

No Input in
Registers

Disable Lo
Interrupts

Reset S-Reg to
Initial Value

Get 50 msec
Elapsed Flag

Set ?
N
Y

Reset 50 msec
Elapsed Flag

Call Time Out
Check (ABTCK)

Set Index to
Highest Priority
Task Queue

Get SOQ Ptr

= 0 ?
N
A
Y

Increment Index
to Next Task
Queue

End
of Task Queue
Ptrs
N
Y

B

Routine: Executive Dispatcher

Processors: AP

(1 of 2)

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REV A

A

Get Task Queues
Entry Fwd Ptr

Put in SOQ Ptr

= 0 ?

Y → Put in EOQ Ptr

N

Save Ptr to
Msg Block

Get Exec
Msg No.

Get Addr of
BECM Task

Enable Lo
Interrupts

Call BECM
Task

B

Disable Lo
Interrupts

Perform Inter-
processor Msg
Polling (EXIPR)

Enable Lo
Interrupts

Jump
to EXDIS

Routine: Executive Dispatcher
Processors: AP

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REV A

GTMNC ( Start )

A-Reg = Request Flag
In RMP version, 0 = CP, 1 = AP
" CP " 0 = RMP, 1 = AP
" AP " 0 = RMP, 1 = CP

Save Registers

Request Flag = 0 → Y → ( A )

N

( B )

(A/B) — — — — — Logic is Identical, but Separate Common Memories are Addressed

Set Lock Flag For This Processor

Get Lock Flag For Other Processor

Set ? → Y

N

Get MCB Free Queue SOQ Ptr

= 0 → Y → Clear Lock Flag For This Processor

N

Add Memory Offset, if Necessary

Get Fwd Ptr From MCB

Put In SOQ Ptr

= 0 → N

Y
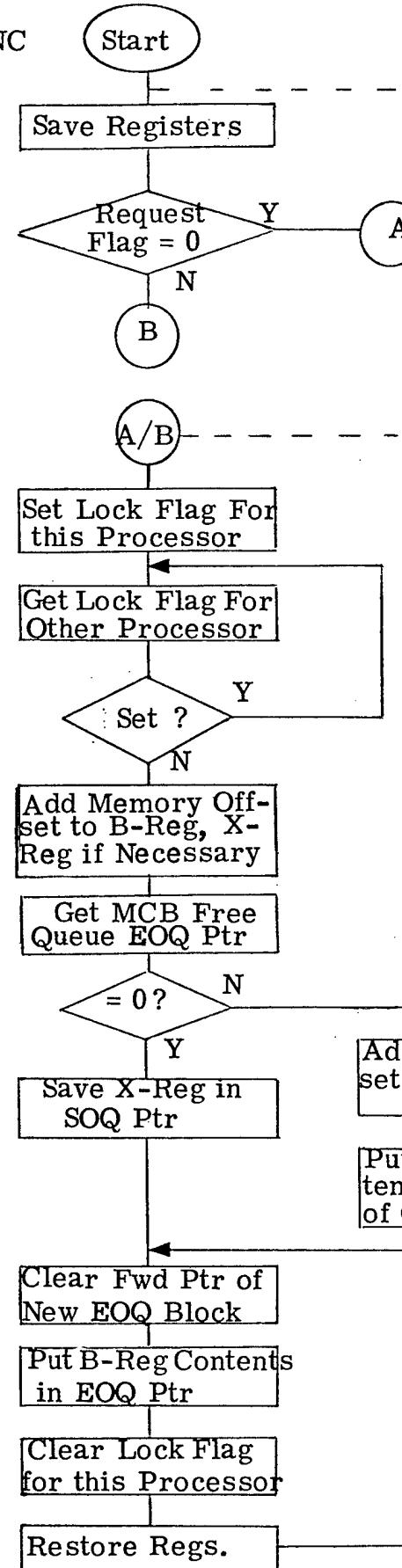
Routine: Get Main Common (MCB Request)

Processors: RMP, CP, AP

Put in EOQ Ptr → Clear Lock Flag for This Processor → Restore Regs. → ( Return )

FRMNC

( Start )

Save Registers

Request Flag = 0 — Y — (A)

N

(B)

(A/B) — — — — — — —
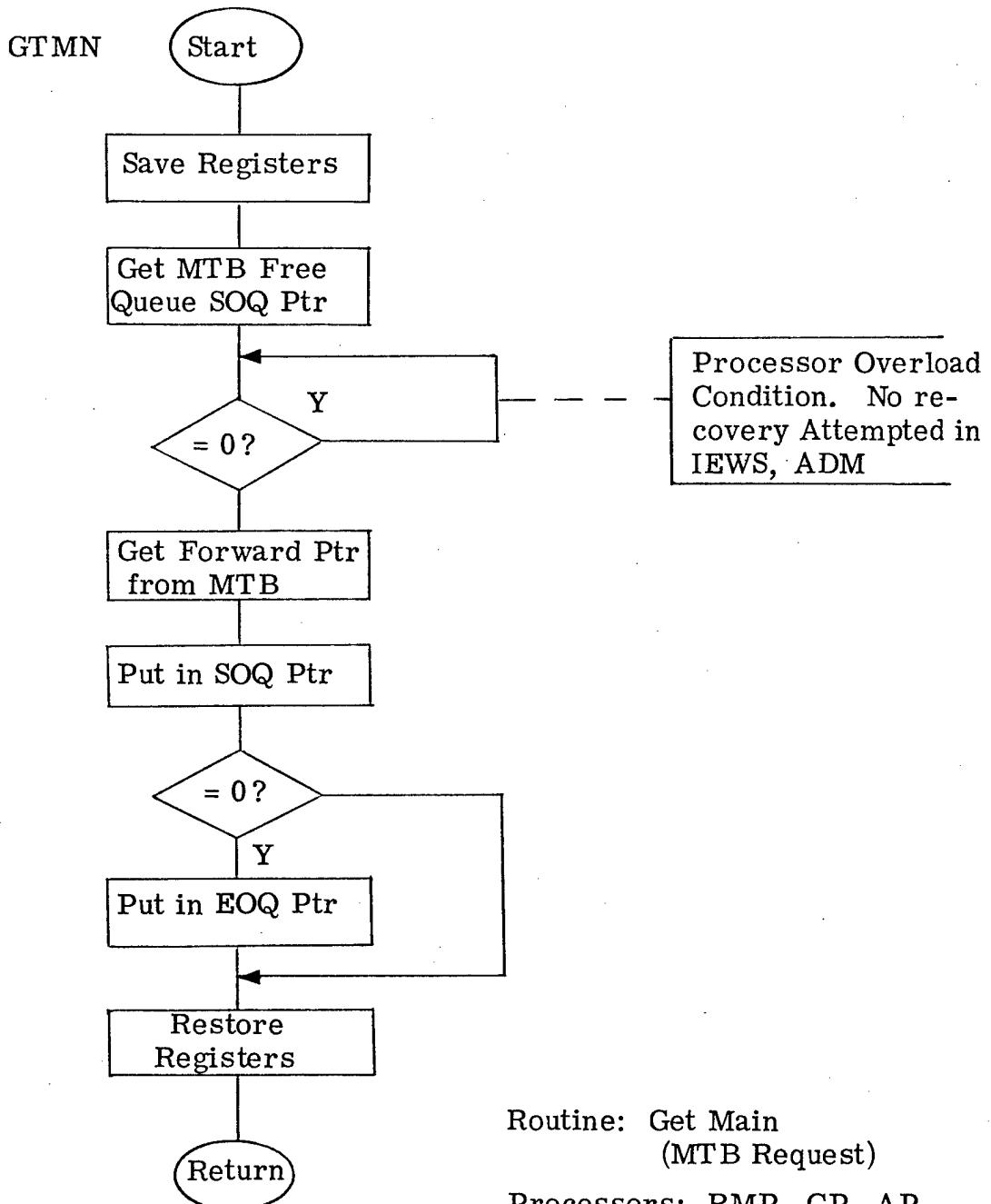
A-Reg = Request Flag
In RMP version, 0 = CP, 1 = AP
  " CP    "     0 = RMP, 1=AP
  " AP    "     0 = RMP, 1=CP
X-Reg = Addr of 1st returned
            block
B-Reg = Addr of last returned
            block

Logic is Identical, but Separate
Common Memories are Addressed

Set Lock Flag For
this Processor

Get Lock Flag For
Other Processor

Set ? — Y

N

Add Memory Off-
set to B-Reg, X-
Reg if Necessary

Get MCB Free
Queue EOQ Ptr

= 0 ? — N

Y

Save X-Reg in
SOQ Ptr

Add Memory Off-
set to EOQ Ptr
Contents

Put X-Reg Con-
tents in Fwd Ptr
of Old EOQ Block

Clear Fwd Ptr of
New EOQ Block

Put B-Reg Contents
in EOQ Ptr

Clear Lock Flag
for this Processor

Restore Regs. → ( Return )

Routine: Free Main Common
           (MCB Return)

Processors: RMP, CP, AP

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REV
A

GTMN ( Start )

Save Registers

Get MTB Free
Queue SOQ Ptr

= 0 ?  — Y — → Processor Overload
Condition. No re-
covery Attempted in
IEWS, ADM

Get Forward Ptr
from MTB

Put in SOQ Ptr

= 0 ?

Y

Put in EOQ Ptr

Restore
Registers

( Return )

Routine: Get Main
(MTB Request)

Processors: RMP, CP, AP

RAYTHEON

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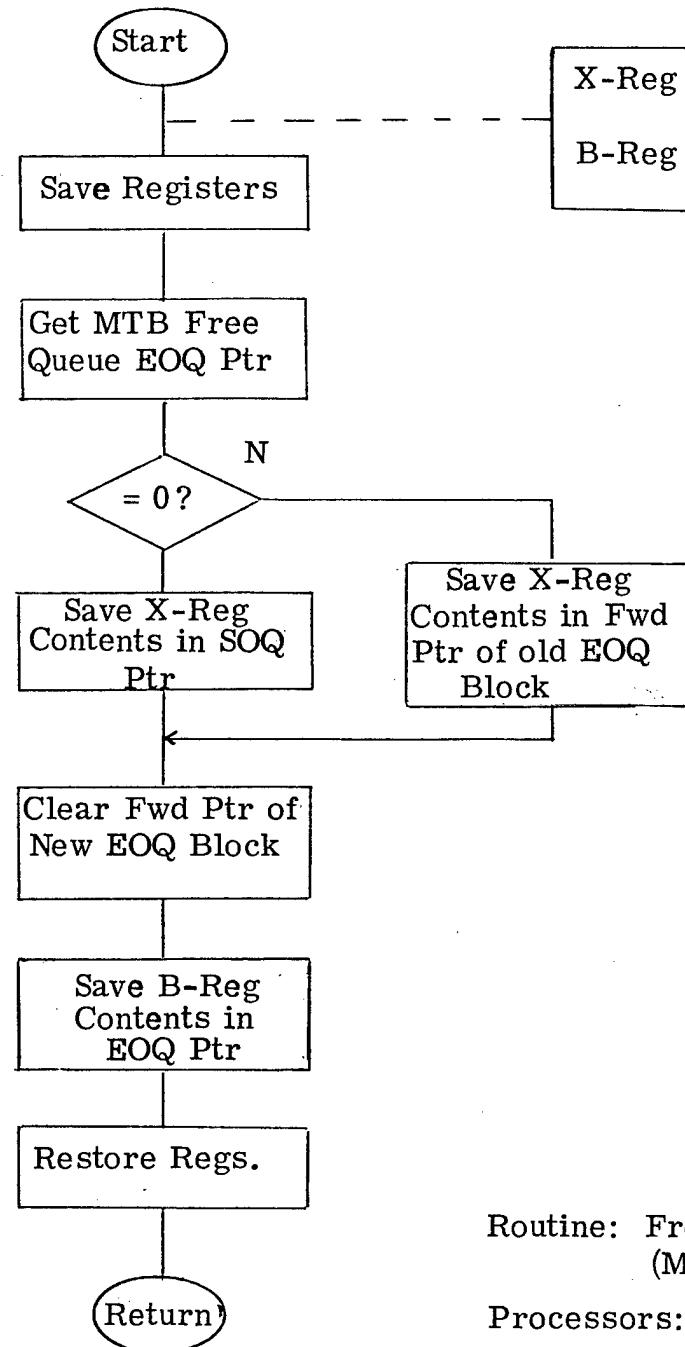
CODE IDENT NO.
49956

SPEC NO.
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REV A

FRMN

( Start )

X-Reg = Addr of 1st Re-
turned Block
B-Reg = Addr of Last Re-
turned Block

Save Registers

Get MTB Free
Queue EOQ Ptr

= 0 ?          N

Save X-Reg
Contents in SOQ
Ptr

Save X-Reg
Contents in Fwd
Ptr of old EOQ
Block

Clear Fwd Ptr of
New EOQ Block

Save B-Reg
Contents in
EOQ Ptr

Restore Regs.

( Return )

Routine: Free Main
(MTB Return)

Processors: RMP. CP, AP

## 3.3    COMPUTER SUBPROGRAM ENVIRONMENT

### 3.3.1    Tables

#### 3.3.1.1    Executive Task Table -

a)  Table Name:        XTASK

b)  Purpose & Type:    XTASK shall be used to determine the address of a background ECM processing task when that task is to be dispatched. XTASK is a fixed length table.

c)  Size & Indexing Procedure:    32 entries of one 16-Bit word. All entries shall be referenced by indexed displacement from the start of the table. Index shall be executive message number.

d)  Entry Format:

15                                                          0

| ADDR |
|---|

| Field | Description | Units | LSB |
|---|---|---|---|
| ADDR | BECM Task Address | N/A | N/A |

#### 3.3.1.2    Message Table -

a)  Table Name:        MTAB

b)  Purpose & Type:    MTAB shall be used by XMES to identify an executive message when it is received by the Executive (received from BECM processing or interprocessor communication) MTAB is a fixed length table.

c)  Size & Indexing Procedure:    32 entries of one 16-Bit word. All entries shall be referenced by indexed displacement from the start of the table. Index shall be executive message number.

d) Entry Format:

| 15 | | | 0 |
|---|---|---|---|
| | Flag | | |

| Field | Description | Units | LSB |
|---|---|---|---|
| Flag | Flag Word<br><br>0 means executive message is to be processed locally<br><br>-1 means message is to be relayed to another processor<br><br>Otherwise, flag is used as the address of a special processing routine for this message type. | N/A | N/A |

### 3.3.1.3 Message Priority Table –

a) Table Name: PTAB

b) Purpose & Type: PTAB shall be used by XMES to determine the priority of an executive message when it has been determined that the message is to be processed locally (i.e., in this processor). PTAB is a fixed length table.

c) Size & Indexing Procedure: 32 entries of one 16-Bit word. All entries shall be referenced by indexed displacement from the start of the table. Index shall be executive message number.

d) Entry Format

| 15 | | | 0 |
|---|---|---|---|
| | Priority | | |

| Field | Description | Units | LSB |
|---|---|---|---|
| Priority | Executive message priority for a given processor. IEWS, ADM has 2 priorities:<br><br>0 = high<br>1 = low | N/A | N/A |

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3.3.2      Variables

None.

3.3.3      Constants

None.

3.3.4      Flags

None.

3.3.5      Indices

None.

3.3.6      Common Data Base References

The RMP Initializer (EXINT) shall set the following common data base items to the initial value:

AZ      Azimuth Link Table

JS      Jam Status File

RF      Resource File

CD      Display/Control Status File

PI      Polar Image File

AN      Alphanumeric Image File

The CP Initializer shall set the following common data base items to the initial value:

ATC     Amplitude Threshold Constant

ETF     Emitter Track File

The AP Initializer shall call subroutine AB2IN to set common data base items to the initial value (see CSDD, ABI Management, IEWS, ADM, Document No. 53959-GT-0754).

3.3.7     Queues

3.3.7.1     Priority Task Queues

    a) Purpose: - The task queues shall be used to hold the backlog of requests for ECM processing in a given processor.  There shall be two queues: high priority and low priority.  Initially, these queues shall be empty.

    b) Queue Definition Variables: -  Each of the two task queues shall be defined by a start of queue (SOQ) pointer (XSOQ$\emptyset$, XEOQ$\emptyset$ for the high priority and XSOQ1 and XEOQ1 for the low priority).  The SOQ pointer contains the address of the oldest entry in the queue or $\emptyset$ if the queue is empty.  The EOQ pointer contains the address of the most recent addition to the queue or $\emptyset$.

    c) Entry Format: - See Figure 4.

3.3.7.2     Free MTB Queue

    a) Purpose: - The Free MTB Queue shall be used to hold the surplus of memory blocks used for dynamic local storage allocation in a given processor.  Inititally this queue shall contain all memory blocks available for use in a processor.

    b) Queue Definition Variables: -   SOQ pointer shall be XSTR. EOQ pointer shall be XEND.  XBUF shall be the low memory address of the memory allocated for MTB's.

    c) Entry Format: - See Figure 5.

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| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|

Word Ø     MSGNO

1     NWDS

2     DATA

3

4

5

6

7

8

.

.

.

.

20

21     FWD PTR

Figure 4a.   Task Queue Entry & Interprocessor Message
Transfer Queue Entry

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| Field | Description | Units | LSB |
|---|---|---|---|
| MSGNO | Executive Message Number | N/A | 1 |
| NWDS | Number of Words of Data | N/A | 1 |
| DATA | Executive Message Data | N/A | N/A |
| FWDPTR | Address of Next Entry in Queue or $\emptyset$ if this Entry is EOQ Entry | N/A | N/A |

Figure 4b.   Task Queue Entry & Interprocessor
Message Transfer Queue Entry

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| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|

Word 0 — FWDPTR

1 — NOT USED

2

3

4

5

6

7

8

21

Figure 5a. Free MTB or MCB Entry

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| Field | Description | Units | LSB |
|-------|-------------|-------|-----|
| FWDPTR | Address of Next Entry in Queue or Ø, if this is EOQ Entry | N/A | N/A |

Figure 5b.   Free MTB or MCB entry.

3.3.7.3   Free MCB Queue

a)   Purpose: - The Free MCB Queue shall be used to hold the surplus of memory blocks used for dynamic interprocessor storage allocation.  MCB's shall be used for interprocessor message storage.  Initially, this queue shall contain all memory blocks available for interprocessor use.

b)   Queue Definition Variables: -

1)   RMP/CP Free MCB Queue -  RCSTR (= CRSTR) shall be the SOQ pointer.  RCEND (= CREND) shall be the EOQ pointer.  RCCOM (=CRCOM) shall be the low memory address of the memory allocated for RMP/CP MCB's.

2)   RMP/AP Free MCB Queue -  RASTR (=ARSTR) shall be the SOQ pointer.  RAEND (=AREND) shall be the EOQ pointer.  RACOM (= ARCOM) shall be the low memory address of the memory allocated for RMP/AP MCB's.

3)   CP/AP Free MCB Queue -  CASTR (= ACSTR) shall be the SOQ pointer.  CAEND (= ACEND) shall be the EOQ pointer. CACOM (= ACCOM) shall be the low memory address of the memory allocated for CP/AP MCB's.

c)   Entry Format: -
     See Figure 5.

3.3.7.4　　Interprocessor Message Transfer Queue

    a)   Purpose: - This queue shall provide the capability to bundle messages during the interprocessor communication process. This communication shall be conducted on a polling (non-interrupt) basis and these queues provide multibuffering of messages. There shall be six of these queues:

      1)   RMP to CP

      2)   CP to RMP

      3)   RMP to AP

      4)   AP to RMP

      5)   CP to AP

      6)   AP to CP

    Initially, these queues shall be empty.

    b)   Queue Definition Variables: - For each of the six queues there shall be a polling flag (RCPOL, CRPOL, RAPOL, ARPOL, CAPOL, and ACPOL, respectively) and a chain pointer (RCPTR, CRPTR, RAPTR, ARPTR, CAPTR, and ACPTR, respectively). The polling flag shall be a count of the messages in the queue or $\emptyset$ if it is empty. The poll is incremented by the sender and decremented by the receiver. The chain pointer shall be the address of the first MCB in the queue.

    c)   Entry Format: -
       See Figure 4.

## 3.4 INPUT/OUTPUT FORMATS

Executive message formats used for intraprocessor and inter-processor communication shall be as specified in the CDBDD, 53959-GT-0751. Sorter message formats shall be as specified in the System Controller - Sorter ICD, 53959-JK-1002.

## 3.5 REQUIRED SYSTEM LIBRARY SUBROUTINES

None.

## 3.6 CONDITIONS FOR INITIALIZATION
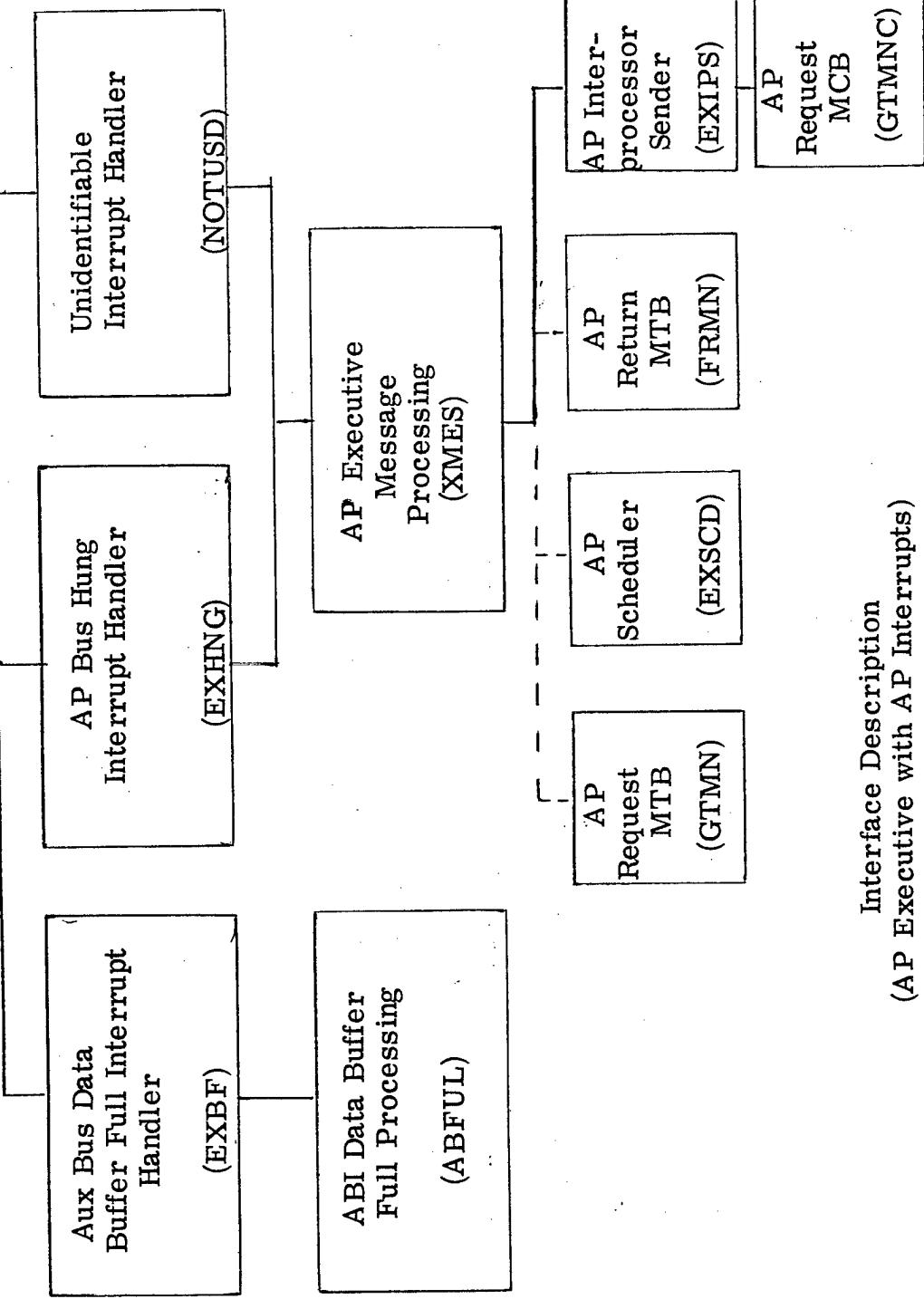
The RMP, CP, and AP shall perform all initialization of IEWS, with the exception of the initialization of the circular buffer used as a depository for STE-destined messages.

## 3.7 SUBPROGRAM LIMITATIONS

An excessive backlog of ECM processing requests will result in the exhaustion of the pool of MTB storage blocks and in effect will terminate all processing in the processor in which overloading occurred. No attempt at recovery shall be made in IEWS, ADM.

## 3.8 INTERFACE DESCRIPTION

The following diagrams describe the interface of the Executive with other IEWS operational software and also the relationship of the various Executive subfunctions.

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REV A

Bus Hung and Aux Bus Data Service Interrupts (Lo-level)

AP Lo-Level Interrupt Handler (EXIH)

Unidentifiable Interrupt Handler (NOTUSD)

AP Bus Hung Interrupt Handler (EXHNG)

AP Executive Message Processing (XMES)

AP Inter-processor Sender (EXIPS)

AP Request MCB (GTMNC)

AP Return MTB (FRMN)

AP Scheduler (EXSCD)

AP Request MTB (GTMN)

RMP-sourced "Real Time Clock" Interrupt (Hi-level)

AP Hi-Level Interrupt Handler (EXTM)

Aux Bus Data Buffer Full Interrupt Handler (EXBF)

ABI Data Buffer Full Processing (ABFUL)

Interface Description
(AP Executive with AP Interrupts)

Bus Hung Interrupt

Sorter Power Fail Interrupt

CP Bus Hung Interrupt
Handler

(EXHNG)

SS Power Fail
Interrupt Handler

(EXSPF)

CP Executive
Message Processing

(XMES)

CP
Request
MTB
(GTMN)

CP
Scheduler

(EXSCD)

CP
Return
MTB
(FRMN)

CP Inter-
processor
Sender
(EXIPS)

Signal
Sorter
Sender
(EXSSS)

CP
Request
MCB
(FTMNC)

Interface Description
(CP Executive with CP Interrupts)

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Sorter Hi-Priority Message
Interrupt

Real Time Clock Interrupt

SS Hi-Priority Msg
Interrupt Handler

(EXIH)

CP Real Time Clock
Interrupt Handler

(EXTIM)

CP
Request
MTB
(GTMN)

CP
Scheduler

(EXSCD)

CP Inter-
processor
Receiver
(EXIPR)

CP
Request
MTB
(GTMN)

CP
Scheduler

(EXSCD)

CP Executive
Message Pro-
cessing
(XMES)

CP Return
MCB

(FRMNC)

CP
Request
MTB
(GTMN)

CP
Scheduler

(EXSCD)

CP
Return
MTB
(FRMN)

CP Inter-
processor
Sender
(EXIPS)

Signal
Sorter
Sender
(EXSSS)

CP
Request
MCB

(GTMNC)

Interface Description
(CP Executive with CP Interrupts)

10-1349 CONT (11/68) VELLUM  PRINTED IN U.S.A.
10-1349 CONT (11/68) FILM

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REV A

Real Time Clock Interrupt

RMP Real Time
Clock Interrupt
Handler
(EXTIM)

Output 1 char-
acter to A/N
display
(DCSEND)

System Mgt. 2
Driver
(SMDR)

RMP Inter-
processor
Receiver
(EXIPR)

RMP Executive
Message Processing

(XMES)

RMP
Return
MCB
(FRMNC)

RMP
Request
MCB
(GTMN)

RMP
Scheduler
(EXSCD)

RMP
Return
MTB
(FRMN)

RMP
Inter-
processor
Sender
(EXIPS)

STE
Sender

(EXSTE)

RMP
Request
MCB
(GTMNC)

Interface Description
(RMP Executive with RMP Interrupts)

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RAYTHEON COMPANY
LEXINGTON, MASS. 02173

CODE IDENT NO. **49956**

SPEC NO.
53959-GT-0756

SHEET 74 OF 78

REV A

Emitter Tracker
Interrupt

Bus Hung Interrupt

Emitter Tracker
Interrupt Handler
(EXET)

RMP Bus Hung
Interrupt Handler
(EXHNG)

RMP Executive Message
Processing
(XMES)

RMP
Request
MCB
(GTMN)

RMP
Scheduler
(EXSCD)

RMP
Return
MTB
(FRMN)

RMP Inter-
processor
Sender
(EXIPS)

STE
Sender
(EXSTE)

RMP
Request
MCB
(GTMNC)

Interface Description
(RMP Executive with RMP Interrupts)

## RAYTHEON

RAYTHEON COMPANY
LEXINGTON, MASS. 02173
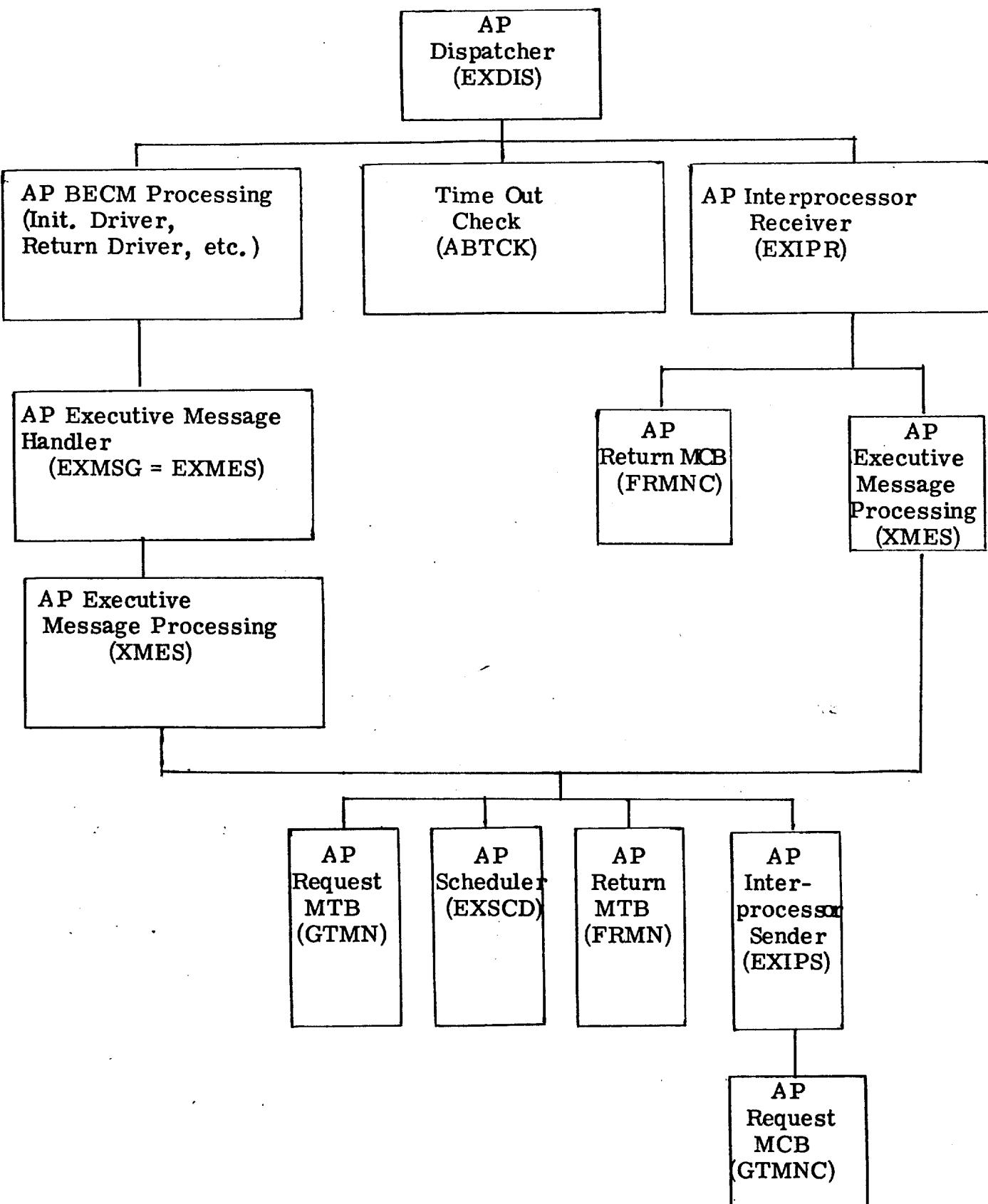
CODE IDENT NO.
49956

SPEC NO.
53959-GT-0756

SHEET
75 OF 78

REV A

```
                        ┌─────────────────┐
                        │       AP        │
                        │   Dispatcher    │
                        │    (EXDIS)      │
                        └─────────────────┘
```

AP BECM Processing
(Init. Driver,
Return Driver, etc. )

Time Out
Check
(ABTCK)

AP Interprocessor
Receiver
(EXIPR)

AP Executive Message
Handler
(EXMSG = EXMES)

AP
Return MCB
(FRMNC)

AP
Executive
Message
Processing
(XMES)

AP Executive
Message Processing
(XMES)

AP
Request
MTB
(GTMN)

AP
Scheduler
(EXSCD)

AP
Return
MTB
(FRMN)

AP
Inter-
processor
Sender
(EXIPS)

AP
Request
MCB
(GTMNC)
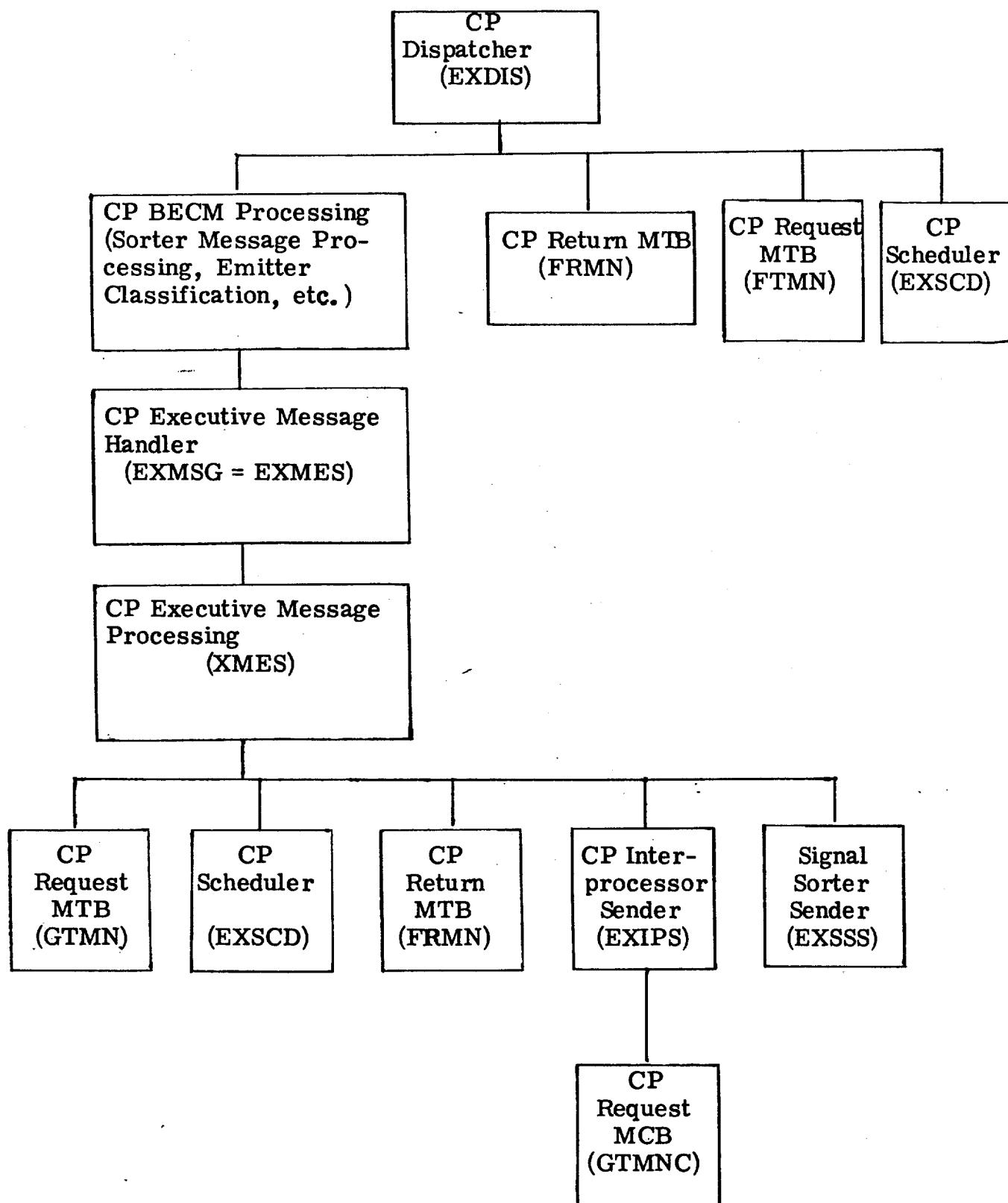
Interface Description
(AP Executive with AP BECM, RMP EXEC, and CP EXEC)

# RAYTHEON

RAYTHEON COMPANY
LEXINGTON, MASS. 02173

CODE IDENT NO.
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SPEC NO.
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REV A

```
                          CP
                      Dispatcher
                       (EXDIS)
```

**CP BECM Processing**
(Sorter Message Processing, Emitter Classification, etc.)

**CP Return MTB**
(FRMN)

**CP Request MTB**
(FTMN)

**CP Scheduler**
(EXSCD)

**CP Executive Message Handler**
(EXMSG = EXMES)

**CP Executive Message Processing**
(XMES)

**CP Request MTB**
(GTMN)

**CP Scheduler**
(EXSCD)

**CP Return MTB**
(FRMN)

**CP Inter-processor Sender**
(EXIPS)

**Signal Sorter Sender**
(EXSSS)

**CP Request MCB**
(GTMNC)

Interface Description
(CP Executive with CP BECM, RMP EXEC, AP EXEC and SS)

Sorter Hi-Priority Message Interrupt

Real Time Clock Interrupt

```
SS Hi-Priority Msg
Interrupt Handler
(EXIH)
```

```
CP Real Time Clock
Interrupt Handler
(EXTIM)
```

```
CP
Request
MTB
(GTMN)
```

```
CP
Scheduler
(EXSCD)
```

```
CP Inter-
processor
Receiver
(EXIPR)
```

```
CP
Request
MTB
(GTMN)
```

```
CP
Scheduler
(EXSCD)
```

```
CP Executive
Message Pro-
cessing
(XMES)
```

```
CP Return
MCB
(FRMNC)
```

```
CP
Request
MTB
(GTMN)
```

```
CP
Scheduler
(EXSCD)
```

```
CP
Return
MTB
(FRMN)
```

```
CP Inter-
processor
Sender
(EXIPS)
```

```
Signal
Sorter
Sender
(EXSSS)
```

```
CP
Request
MCB
(GTMNC)
```

Interface Description
(CP Executive with CP Interrupts)

**RAYTHEON**

RAYTHEON COMPANY
LEXINGTON, MASS. 02173

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RMP Dispatcher (EXDIS)

Tech. Gen. Initializer

System "GO" Command from IEWS Loader

RMP Initializer (EXINT)

ABI Mgt Initializer (AB2IN)

AP Initializer (EXINT)

AP Dispatcher (EXDIS)

CP Initializer (EXINT)

CP Dispatcher (EXDIS)

Signal Sorter Initializer

Interface Description (System Initialization)